Death, Hope and Sex Revisited: An Evaluation of Psychosocial Acceleration Theory

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Abstract

Psychosocial Acceleration Theory (Belsky, Steinberg & Draper, 1991; Chisholm, 1993; 1999a) is an explanatory framework that recasts behaviours viewed as deviant or pathological (such as aggression and early reproductive behaviour) as adaptive strategies for individuals developing in high stress environments. Chisholm and later theorists linked disrupted attachment process during early childhood to perceptions of an uncertain future and local mortality rates. Uncertain futures cause individuals to focus on present consumption (shortening "time preference") to avoid lineage extinction through accelerated reproductive function and competitive behaviours. Questions remain as to the details of how this process operates; specifically, the identification of environmental stressors, the specification of Chisholm's "time preference" mechanism and the role of biological sex.

This thesis evaluated psychosocial acceleration theory by exploring these questions. The combined empirical evidence from seven studies (using primary and secondary data) generally supports and extends psychosocial acceleration theory as a framework for explaining how and why various behaviours cluster together in predictable ways and how these life history trajectories represent alternative, conditional strategies shaped by environmental experiences. Evidence suggests that sex-ratio, population density, socioeconomic stress, low education and shorter life expectancies represent distinct sources of stress that promote greater family instability, which in turn, increases aggression, crime, teenage pregnancies and reproductive development. However data also suggest (somewhat contrary to Chisholm) that these same environmental factors can act independently of family instability. Psychological traits (particularly sensation seeking and impulsivity) that meet key predictions derived from Chisholm's work are discussed as mediating mechanisms representative of "time preference" linking perception of ecological stress with behaviour. The role of biological sex, whilst in line with many evolutionary derived predictions, demonstrates distinct pathways for males and females. Future work and limitations are discussed in commentaries throughout in relation to pertinent evolutionary literature.

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Declarations

All material presented in this thesis was produced between September 2007 and September 2014 at the Department of Psychology, Durham University. The material presented herein has not been submitted previously, in part or in whole, at any other institution or for any other qualification.

Publications and Contributions

The structure of this thesis is based principally around seven papers that at the time of submission (September 2014) were either published, in press or under review. These are listed in order of appearance below along with a description of the relative contributions of each author.

Copping, L.T., Campbell, A., & Muncer, S. (2014). Psychometrics and life history strategy: the structure and validity of the High-K Strategy scale. *Evolutionary Psychology*, 12, 200-222. Publication was written by Copping, L.T. Data was analysed by Copping, L.T. and Muncer, S. Editorial work and suggested improvements was conducted by Campbell, A.

Copping, L.T., Campbell, A., & Muncer, S. (2013). Violence, teenage pregnancy and life history ecological factors and their impact on strategy driven behaviour. *Human Nature*, 24, 137-157. doi:10.1007/s12110-013-9163-2. Publication was written and data was analysed by Copping, L.T. Editorial work and suggested improvements was conducted by Campbell, A. and Muncer, S.

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I'd also like to thank the many friends I have made on the road to completing this thesis who have supported me through my time in the department. Studying over such a long period of time was not always easy and I owe debts of gratitude to those who have somehow managed to keep me sane in the process, in particular (and in no particular order), Kate Cross, Keira Ball, Marina and Marco Hirnstein, Constanze Hesse, David Knight, Susan Scrafton, Helen Knight and Alison Lane. I frankly could not have asked for better company over my time at Durham University.

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Dedication

This thesis is dedicated to the memory of John Derek Copping who, whilst unfalteringly supportive of my work, would doubtlessly have disagreed with every word contained herein.

Notes on formatting

1) Much of the material provided in this thesis is either published work, in press or under review. Such material is highlighted by the presence of page borders.

2) Some of the published material required American English spelling. As such, this thesis has adopted UK English spellings throughout for the sake of consistency. Exceptions are made for references due to the adoption of APA style and direct quotations from other sources.

3) Some of the published material required differences in text citation formats. All citations herein have been presented to conform with APA guidelines for consistency throughout.

CHAPTER ONE

Evolution, Life History and Psychosocial Acceleration Theory

1.0. Introduction

Society treats some behaviours as maladaptive or deviant (e.g. aggression, crime, sexual precocity). Interestingly, research suggests these behaviours often cluster together, arise from similar aetiological conditions and share many commonalities of expression such as age profiles, sex differences and correlations with other trait-like variables. Recent works (Pickett, Mookherjee & Wilkinson, 2005; Wilkinson and Pickett; 2009) even show that nations that have a high incidence of one of these behaviours have high incidences of other "deviant" behaviours. This thesis evaluates an evolutionary account that offers a mechanistic explanation of how such patterns emerge: Psychosocial acceleration theory (Belsky, Steinberg & Draper 1991; Chisholm, 1999a). Two of these behaviours are examined in detail (reproductive behaviour and aggression) to demonstrate how and why they are linked and are ultimately, adaptively attuned to their environment. Consideration will first be given to the evolutionary origins of aggression and reproductive behaviour before highlighting their similarities.

1.1. Reproductive behaviour and aggression

'Reproductive behaviours' in the context of this thesis refer to separate but related behaviours: 1) reproductive onset, 2) coital onset, 3) birthing age, 4) number of sexual partners. Research indicates that pacing of these behaviours is closely linked within and between human populations (i.e. early maturation › early reproduction › greater reproductive effort › more partners, Belsky, et al., 1991; Chisholm, 1999a) and across species (Pianka, 1970; Roff, 1992; Stearns, 1992) suggesting that they form a coordinated suite that may have an adaptive function.

Aggression is a complex, multidimensional behaviour. It exists across species and is expressed across all cultures, socioeconomic backgrounds, sex and age groups and takes multiple forms (Weinshenker & Siegel 2002). In terms of form, it can be direct or indirect, relational or social (Archer & Coyne, 2005), verbal and nonverbal (Bjorkqvist, Lagerspetz & Kaukiainen, 1992), proactive (instrumental) and reactive (hostile; Berkowitz, 1993), violent and non-violent (Anderson & Bushman, 2002). Aggression is "behavior directed toward another individual that is carried out with the proximate (immediate) intent to cause harm. In addition, the perpetrator must believe that the behavior will harm the target, and that the target is motivated to avoid the behavior" (Anderson & Bushman, 2002, p.28). This thesis concerns itself mainly with any behaviour fitting this definition, including violence (acts resulting in physical harm) or aggression aimed at causing other forms of harm (to reputation or status), although it does not examine the specific forms alluded to earlier. As data suggest that forms of aggression are moderately to strongly correlated (whilst still conceptually independent) with each other (Crick & Grotpeter, 1995; Little, Henrich, Jones & Hawley, 2003; Salmivalli, Kaukiainen & Lagerspetz, 2000; Vitaro, Brendgen & Tremblay, 2002), this thesis concerns itself with what causes aggression at more distal and ultimate levels. As this thesis focuses on evaluating a theory developed within an evolutionary perspective, it will focus on aggression as conceived of from the perspective of evolutionary biology and

psychology. Alternative disciplinary perspectives on aggression exist but their breadth makes it impossible to incorporate them all, as Campbell (2005) cogently illustrates; "Aggression has been taken to be innate and learned, universal and culturally prescribed, a pervasive trait and a contextualised response, functional and dysfunctional, behavioural and cognitive and a phenomenon not to be measured and modelled or experienced and described" (p.68).

Reproduction and aggression are both shaped by evolution to facilitate individual survival. The association between the two behaviour patterns extends beyond the origin of their evolved functions however. Evidence suggests that these behaviours are intrinsically linked. In humans, young male offenders are more likely to have sex earlier and father children younger (Wei, Loeber & Stauthamer-Loeber, 2002). Higher delinquency scores tend to correlate strongly to earlier sexual activity and the seeking of more partners (Lalumiere & Quinesey, 1996; Rowe, Vasonyi & Figeuerdo, 1997). Individuals with accelerated pubertal development and earlier sexual activity also develop more aggressive tendencies in later life and/or were exposed to violence in the family during development (Capaldi, Crosby & Stoolmiller, 1996; Kim, Smith & Paermitti, 1997; Najman, Hayatbakhsh, McGee, Bor, O'Callaghan & Williams, 2009; Quinlivan, Tan, Steele & Black, 2004; Stattin & Magnusson, 1990; Tremblay & Frigon, 2005; Ge, Conger & Elder, 1996).

1.2. Parental investment and sexual selection

Reproductive and aggressive behaviours vary across species due to sex differences in fitness variance (Bateman, 1948). Sexual reproduction involves the fusion of two gametes: one large, one small. The sex with the largest investment (usually female) tends to be a limiting factor for the sex with the smaller investment (usually male; Trivers, 1972). This differential investment of bioenergetic resources creates differences in the propensity of the sexes to invest in mating (e.g. acquiring more sexual partners) or parenting (raising offspring). For males, reproductive investment can potentially end at conception. For females, investment entails gestation, lactation and resource acquisition to sustain offspring. Whilst males can quickly re-enter the mating pool and repeat this process with other females, females cannot usually return to the mating pool for some time after birthing, creating a skewed operational sex ratio.

Directing their energy to parenting is a more advantageous strategy for females to ensure genetic survival, despite the resource burden of reproduction reducing their reproductive rate. The sex with the lower rate of reproduction therefore benefits more from parenting than mating (Clutton-Brock & Vincent, 1991). Male reproductive rate is potentially higher due to the absence of obligatory costs associated with gestation or postnatal care (Bateman, 1948; Clutton-Brock, 1991; Trivers, 1972). However, whilst female reproductive rates are lower they are rarely unable to find a mate, thus reducing female reproductive variance. In males, potential reproductive rate has no ceiling and reproductive variance is much higher (Wilson, Daly & Pound, 2002). This is because males must compete for copulations either through female choice or aggressive intrasexual competition. Females (who are investing more) aim for a good return on their investment, usually in the form of high genetic quality or male investment in offspring. As Trivers explains "The sex whose typical parental investment is greater than that of the opposite sex will become a limiting resource for that sex. Individuals of the

sex investing less will compete among themselves to breed with members of the sex investing more" (Trivers, 1972, p.140).

Whilst this pattern holds true for most species, it should be noted that some exhibit sex role reversals, including species of polyandrous birds, antelope, hyenas and meerkats (Bro-Jørgensen, 2007, 2011; Holekamp, Smale & Szykman, 1996; LeBas, 2006; West-Eberhard, 1983). Reversals tend to be specific to local mating systems such as cooperative breeding (Aubin-Horth, Desjardins, Martei, Balshine & Hofmann, 2007), mutual mate choice (Kraaijeveld, Kraaijeveld-Smit & Komdeur, 2007), and polyandry or promiscuity (Clutton-Brock, 2009). Whilst the traditional sex role view of mating versus parenting is the predominant position in the evolutionary sciences, challenges have been made to this theory (Brown, Laland & Borgerhoff-Mulder, 2009). Research indicates that increased mating effort in females can carry advantages (Hrdy, 1981; Jennions & Petrie, 2000; Wolff & MacDonald, 2004) and that investment in mating versus parenting by males and females is likely subject to many ecological interactions such as sex ratio fluctuations, population density and sex-specific mortality (Kokko & Jennions, 2008). Whilst this thesis will revisit some of these suggestions in later chapters, it should be noted that the traditional perspective will be maintained throughout.

Differences in fitness variance shape sexual selection (Bateman, 1948), with males competing for females and females aiming to maximise access to high quality males. Male competition for mating opportunities fostered sexual dimorphisms that enhanced male reproductive success (either through removing competitors or being selected by females). In the northern elephant seal for example (*Mirounga angustirostris*), physical size is a sexually-selected characteristic for establishing social dominance. Larger males monopolize access to females and defend against subordinate males attempting copulations within their territory. Male-male competition is fierce: over 75% of all seal pups are sired by less than 5% of available adult males (Le Boeuf & Peterson, 1969; Le Boeuf & Reiter, 1988). Only 10% of males survive to reproduce. Cox and Le Boeuf (1977) suggested that females deliberately attempt to mate with socially dominant males by 'protesting' against the advances of subordinates. This typically precipitates further conflict between males, allowing females to effectively choose or test between partners. Physical size in the elephant seal not only allows males to compete but acts as a quality signal to females, increasing the likelihood of the largest males reproducing. In humans, sexual dimorphisms (such as facial hair, voice pitch, physical size etc.) appear to have evolved as a result of selection by females (Addison, 1989; Apicella, Feinberg & Marlowe, 2007; Archer. 2009; Pheasant, 1983; Puts, 2005; Putts, Gaulin & Verdolini, 2006; Xiao, Lei, Dempsey, Lu & Liang, 2005) whilst aggression can increase male fitness benefits (Chagnon, 1988; Grauer & Stuart-Macadam, 1998; Torres-Rouff & Junqueira, 2006; Zerjal et al., 2003).

Parental investment theory (Trivers, 1972) explains observable sex differences in reproductive and aggressive behaviours. Males should more actively invest in mating over parenting behaviours due to low investment costs: a premise borne out in the human literature (Buss & Schmitt, 1993; Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008; Schmitt, 2005; Simpson & Gangestad, 1991; Trivers, 1972). Polygyny and serial monogamy should also benefit males more than females (Forsberg & Tullberg, 1995; Jokela, Rotkirch, Rickard, Pettay & Lummaa, 2010). Females reach reproductive maturity earlier than males (de La Rochebrochard, 2000; Dorn, Dahl, Woodward & Biro, 2006; Geary, 1998; Grumbach & Styne, 2003). Males

are reproductively viable across the lifespan but need to invest time in growth prior to entering the male competitive arena (Archer, 2009), thus secondary sexual characteristics develop later (Dorn, Dahl, Woodward & Biro, 2006; Geary, 1998; Grumbach & Styne, 2003). Males however usually engage in coitus earlier than females (Day, 1992; Laflin, Wang & Barry, 2007; Upchurch, Levy-Storms, Sucoff & Aneshensel, 1998) perhaps because early coitus in females risks early pregnancy, which is more likely to result in birthing complications or low birth weight offspring (Chen, Wen, Felming, Demissie, Rhoads & Walker, 2006; Leppalahti, Gissler, Mentula & Heikinheimo, 2013). Males show more physical and direct aggression than females from as early as 17 months, with the difference in magnitude being maintained across the course of development (Archer, 2009; Archer & Coté, 2005; Baillargeon et al., 2007; Bettencourt & Miller, 1996; Bjorkland & Pellgrini, 2000; Card, Stucky, Sawalani, & Little, 2008; Coté, Vaillancourt, Barker, Nagin, & Tremblay, 2007; Daly & Wilson, 1988; Del Giudice, 2009; Eagly & Steffen, 1986; Osterman, Bjoerkqvist, Lagerspetz, Kaukiainen, Landau, et al, 1998). Sex differences are less marked for indirect forms of aggression as females can benefit from low-risk intrasexual competition to prevent female rivals from gaining access to high-quality mates and other resources (Archer, 2009; Bjorkqvist, Osterman, & Lagerspetz, 1994; Campbell, Sapochnik, & Muncer, 1997; Leenars, Dane & Marini, 2008). However, as maternal injury or death has a more detrimental impact on offspring survival (in approximately 95% of mammalian species, juvenile care comes predominantly from the mother; Clutton-Brock, 1991), females are more harm-avoidant and thus direct aggression is low relative to males (Campbell, 2005).

Parental investment theory and sexual selection theory also predict that competitive and reproductive behaviours, should peak at the same point in the lifespan. Evidence suggests this is so in humans. Levels of aggression and crime increase during the teens and peak in the twenties, then decline steadily as a function of increasing age, independent of sex or socioeconomic status, (Fabio, Tu, Loeber & Cohen, 2011; Feldmeyer & Steffensmeier, 2007; Sampson & Laub, 2003; Steffensmeier, Allan, Harer & Streifel, 1991; Steffensmeier & Streifel, 1991). For women, most offspring production occurs between the ages of 20 and 30, before fertility, fecundity and mate value begin to decline (Dunson, Colombo & Baird, 2001; Hull, Fleming, Hughes & McDermott, 1996; Migliano, Vinicius & Lahr, 2007; Pennington & Harpending, 1993; Wilson & Daly, 1997). For men, sexual interest and desire peak in the twenties and decline generally from age 30, as does fecundity (Aggarwal, 2013; Beutel, Stobel-Richter & Brahler, 2008; Dunson, Colombo & Baird, 2001; Ford, North, Taylor, Farrow, Hull & Golding, 2000; Gagnon, 1977; Laumann, Gagnon, Michael & Michaels, 1994; Schmitt et al., 2002).

1.3. Further aggressive and reproductive commonalities

Researchers have noted other commonalities between reproductive and competitive behaviours, mainly the similarity of their associations with environmental antecedents and personality traits.

The most violent and criminogenic environments are characterised by low opportunity, low social mobility, and scarce monetary resources, whilst poverty and low socioeconomic status are also key risk factors for early onset reproduction in men and women (Brewster, 1994a, 1994b; Brooks-Gunn, Duncan, Klebanov & Sealand, 1993; Burton, 1990, Coulton, Korbin, Su & Chow, 1995; Cunradi, Caetano, Clark & Schafer, 2000;

Diem & Pizarro, 2010; Huff-Corzine, Corzine & Moore, 1991; Kirby, Coyle & Gould, 2001; Kposowa, Breault & Harrison, 1995; Lanctot & Smith, 2001; Masi, Hawkley, Piotrowski, & Pickett, 2007; Oberwittler, 2007; Sabates, 2008; Singh, Darroch, Frost et al., 2001; Wallace & Wallace, 1998; Wilkinson, Kawachi & Kennedy, 1998; Wilkinson & Pickett, 2009). Hand in hand with economic deprivation is lack of educational opportunity and achievement (Dobrin, Lee & Price, 2005; Hansen, 2003; Hockaday, Crase, Shelley & Stockdale, 2000; Laflin, Wang & Barry, 2001; Limbos & Casteel, 2008; Lohman & Billings, 2008; Singh et al., 2001; Staff & Kreager, 2008; Were, 2007). Negative sex ratios (biased towards an excess of females) have been associated with the proliferation of aggression and increased reproductive behaviours (Barber, 2000a, 2000b, 2001, 2003, 2009, 2011; Guttentag & Secord, 1983; Messner & Sampson, 1991; Pederson, 1991; South & Messner, 1987), although some researchers suggest the relationship could be curvilinear, with male-skewed populations having the same effect (Barber, 2003; Del Giudice, 2012; Kokko & Jennions, 2008; Pederson, 1991). Life expectancy and neighbourhood health also impact on rates of aggression and early reproduction (Chishom, Quinlivan, Petersen & Coall, 2005; DuRant, Cadenhead, Pendergrast, Slavens, & Linder, 1997; Wilson & Daly, 1997). Although many of these factors are correlated with each other (making unique causality difficult to assign), it is clear that challenging combinations of environmental features foster higher levels of aggression, crime and earlier initiation of reproductive behaviours.

At the individual level, similar personality traits have been implicated in both aggressive and reproductive behaviours. One frequently studied trait is impulsivity (an ambiguous umbrella term that encompasses traits such as risk, sensation seeking, deliberative failure and inability to defer gratification to name but a few; see Evenden, 1999 for a review). Research has consistently shown that aggressive and sexually precocious individuals tend to be more impulsive, are more likely to take risks, seek sensation, and are more responsive to appetitive motivation (Chisholm, 1999a; Ellis, 1988; Feldman & Brown, 1993; Fossati, Barratt, Borroni, Villa, Grazioli & Maffei, 2007; Gottfredson & Hirschi, 1990; Kahn, Kaplowitz, Goodman & Emans, 2002; Lorber, 2004; Luengo, Carillo-de-la-Pena, Otero & Romero, 1994; McAlister, Pachana & Jackson, 2005; Perez & Torrubia, 1984; Raffaelli & Crockett, 2003; Raine, Reynolds, Venables, Mednick, & Farrington, 1998; Simo & Perez, 1991; Smith, Waterman & Ward, 2006; Vigil-Colet & Codorniu-Raga, 2004; White & Johnson, 1988; Zuckerman, 1989; Zuckerman, Bone, Neary, Manglesdorff & Brustman, 1972; Zuckerman & Kuhlman, 2000). Impulsivity appears to be a key personality variable affecting aggressive and reproductive behaviour. In summary, there are striking similarities in the demographic, ecological and personality correlates of competitive and reproductive behaviours.

1.4. Evolution and life history theory (LHT)

The evolutionary sciences offer an approach that can explain the similar profiles associated with violent and sexual behaviours as part of a causally driven, mechanistic approach to development: Life History Theory (LHT). LHT is a mid-level theory describing processes by which behavioural responses should be selected for expression, and to what extent, within an ecological niche. A crucial principle is that development and reproduction require investment from a finite resource pool, forcing organisms to make trade-offs. Phenotypic variation, within and between species and generations, result from resource limited trade-offs which translate into variation in reproductive fitness (Roff, 1992; Stearns, 1992).

Organisms make investments in somatic development and reproductive effort. The trade-off between them is a fundamental issue in an organism's lifespan. Known as the general life history problem or the current vs future trade-off (Charnov, 1993; Schafer 1983; Stearns 1992), it is the choice between continuing to grow or commencing reproduction. Continued somatic investment brings health benefits, time to foster competitive skills and to accrue resources to assist in future child rearing at the expense of shortening the reproductive window. Risks associated with earlier reproduction however include potential health problems and child rearing with fewer accrued resources. This trade-off not only affects immediate chances of reproduction but lifetime inclusive fitness also. Reproducing early carries the advantage of having first and second generation offspring earlier, allowing continued investment through alloparental care. Other trade-offs also exist (Stearns, 1992). For example, having fewer children allows finite resources to be partitioned into greater shares, potentially reaping future advantage. However the loss of a small number of offspring in which resources have been heavily invested could be catastrophic. Having more children means resources are stretched thinly but increases the chances that at least one will survive to reproduce (a quality vs. quantity trade-off). Life history tempo is therefore contingent on the ecological context that conveys information to individuals, informing resource investment in a manner that will facilitate reproductive fitness. These decisions have far reaching consequences for behaviour and form the core of life history strategies.

LHT was initially used to classify phenotypic variation between species and centred on the idea that variation existed along a continuum between the carrying capacity of the environment, *K* and the maximal rate of expansion of a species within the environment, *r* (MacArthur & Wilson, 1967). Species reproduce rapidly until they approach carrying capacity, which forces a shift to more efficient use of increasingly finite resources (fostering *K*). A species' position along the continuum (thus its physical and behavioural variations) is ultimately determined by the density dependent factors in the environment on approach to environmental saturation (increasing levels of competition). This *r-K* framework was used extensively to classify species in the biological and evolutionary sciences in terms of their phenotypic variation (see Eisenberg, 1981; Pianka, 1970), based on dimensions such as reproductive rate, body size, and aggressiveness among others. Furthermore, the continuum was extended to within-species variation within humans (see Ellis, 1987; Rushton, 1985 for examples) as a means of exploring individual differences.

Later research however noted many inconsistencies in the r/K continuum (documented in more detail in Chapter Two). More recent theorists emphasised the pivotal role of age-specific mortality rates (Ellis, Figueredo, Brumbach & Ssclomer, 2009; Promislow & Harvey, 1991; Stearns, 1992) over density dependent effects. As such, this traditional dimensional view of LHT has been less evident in recent literature (Chisholm, 1999a; Stearns, 1992; although this will be explored again in Chapter Two) and is thus not the focus of this thesis. Current human life history strategy research emerges in the form of two distinct frameworks: Psychosocial acceleration theory and Differential-K. The former is the focus of the current thesis; their conceptual differences and similarities will form the basis of Chapter Two. The development of psychosocial acceleration theory will be discussed in detail below.

1.4.1. Life History Strategies in the context of human development

Attachment research has a strong basis in evolutionary theory. Bowlby (1969) proposed that attachment to primary care givers was an adaptation allowing individuals to develop and explore their environments. The ultimate function of the bond between parent and child was to protect offspring from danger, allow them to develop securely and to reproduce into the next generation. Bowlby proposed that this bond would have ensured survival in the ancestral environment of evolutionary adaptedness (EEA). Whilst developmental psychology strayed from evolutionary principles, later research in attachment and its consequences consistently highlighted one finding: Father absence appeared to have detrimental effects on child development and the future life outcomes of these children were likely to be compromised (Biller, 1981; Hetherington, 1972; but see Draper & Harpending, 1982, for a review of these findings). This finding refocused attention on the evolutionary origins of bi-parental care. Draper and Harpending (1982) proposed that the presence or absence of a male parent conveyed information to developing children and could be responsible for the later behaviour patterns of adolescents. They also asserted that the effects of father absence were more prominent in low socioeconomic households and had different effects for males and females. In their review of father absence research, they argued that boys reared without a father were more likely to be aggressive and competitive, and less interested in parenting behaviours than boys from a nuclear family. Girls on the other hand were more likely to demonstrate a precocious interest in sexual activity and less interest in monogamous pair bonding. They argued that the presence or absence of a father at a critical period of sensitivity in child development (between ages one to five years old) could establish a developmental trajectory geared towards a particular reproductive strategy. The presence or absence of a father conveyed information about forthcoming investment levels. Father absence generated the belief that paternal investment was unreliable. Males therefore develop to exploit resources whilst females mature with the impression that male partnerships are rare and unstable.

Belsky, Steinberg & Draper (1991) developed this theory into a full model of child development. It was not originally clear why father absence was so important. For instance Hetherington (1972) noted that outcomes were not necessarily negative for children of widows (despite the fact that widowhood still entails father absence). Belsky et al., demonstrated that it was not father absence per se driving reproductive strategy, but the stress that the absence of a father caused in relation to parent-child socio-affective experiences. Father absence meant fewer resources being allocated to children. The strain this would put on child-rearing mothers would manifest itself in behaviour towards the child. Children developing under conditions of marital stress, poor socioeconomic surroundings and single parenthood are more likely to experience inconsistent or negative parenting and will form an internal working model consistent with an insecure attachment style (see Ainsworth, Blehar, Waters & Wall, 1978; Bowlby, 1969). The attachment bond between mother and child would begin to orient that child to towards a reproductive strategy consistent with Draper and Harpending's original predictions. In short, it is contextual stress (with father absence being one of many potential stressors) at the period of critical sensitivity in childhood that begins the chain of events that establish reproductive strategies. Contextual stress is therefore seen as a more distal influence on strategy development, whilst parental interactions (under the effects of contextual stress) with children become proximal causes.

This theory and its later instantiations are referred to as psychosocial acceleration theory and it made specific predictions grounded in evolutionary literature about the nature of development. It posited that a complex, environmentally-sensitive developmental system (calibrated in the first five to seven years of life) evolved as a mechanism in human evolutionary history that enhances future reproductive fitness by optimally equipping the individual to exploit local ecological conditions. As such, reproductive schedules are accelerated or decelerated accordingly. Those who develop in high-stress environments should develop a strategy that is reproduction focused, reaching puberty earlier, displaying sexually precocious behaviour and making little effort to establish stable pair bonds. Individuals developing in stable environments will focus less on reproductive behaviours. Puberty should therefore be delayed and greater interest should be shown in parenting as opposed to mating behaviours. This "fast/slow" tempo continuum of development underpins much of the work presented in this thesis. Belsky et al., (1991) provided a significant body of evidence to support the various propositions within their model. Furthermore, research testing the components of the model has generally supported the notion that stress (and not father absence per se) is the crucial element in determining key reproductive milestones and hence, strategy development (Belsky, Schlomer & Ellis, 2011; Belsky, Steinberg, Houts, Friedman, DeHart, Cauffman & The NICHD Early Child Care Research Network, 2007; Ellis, 2004; Ellis & Essex, 2007; Nettle, Coall & Dickins, 2010, 2011).

1.4.2. Refinements to psychosocial acceleration theory

Further important developments to psychosocial acceleration theory were made by Chisholm (1993, 1996, 1999a, 1999b). Whilst endorsing Belsky et al.'s, (1991) model, Chisholm sought to clarify the mechanisms involved in the process by which early experience impacts upon strategy. Chisholm explicitly integrated life history theory with the earlier works of Belsky et al. to achieve this. Chisholm claimed this system was designed to solve what Plotkin (1994) termed the "uncertain futures problem". Organisms spend time in development prior to reproduction. Whilst the human genome is an embodied problem-solving schematic based on ancestral problems, the genes that were successful for parents may not be so to their progeny, as the gap between their birth and subsequent reproduction may cover a period of ecological change. Development should therefore show a degree of plasticity, allowing individuals to track the local environment and prepare for it, helping them to make predictions about the future and to shape their development accordingly. Chisholm's central concerns were with what environmental features organisms track and how they do so in order to make reproductively-optimal decisions. In short, how do they solve Schafer's (1983) problem of determining when to reproduce (the current versus future problem)? The individual who can effectively predict the future and respond plastically to survive and reproduce is likely to be more successful (Chisholm, 1999a, Holland, 1992; Plotkin, 1994). Two developments of the theory are pertinent to this thesis and are briefly described here. They are considered further in Chapters Three and Four.

1.4.2.1. The environment and mortality

First of all, Chisholm sought to clarify the nature of environmental stress. The attachment mechanism remains the key to the developing child and the stress experienced by the family unit is the proximal cause of strategy trajectory. As such, Chisholm postulated that uncertainty regarding local mortality was the key

selection pressure in the evolution of this system. By tying stress to local mortality rates, a framework emerged for the types of environmental cues to which parents would be sensitive. Anything within the environment that would cause parents to 'expect' shorter life expectancies (and thus affect their own reproductive fitness and that of their children) would be indirectly conveyed to the developing child through the attachment bond (manifesting in inconsistent/harsh parenting behaviours). The expectancy of a shorter life would give an individual reason to believe (not necessarily consciously) that an accelerated reproductive schedule with faster breeding and more children may be the only safeguard against lineage extinction. The effects of mortality risks and expectations regarding the future on life history behaviours and decision making have been well documented (Chishom, Quinlivan, Petersen & Coall, 2005; DuRant, Cadenhead, Pendergrast, Slavens, & Linder, 1997; Geronimus, 1996; Griskevicius, Delton, Robertson & Tybur, 2010; Low, Hazel, Parker & Welch, 2008; Nettle, 2010; Wilson & Daly, 1997).

1.4.2.2. Time preference

Chisholm also united this idea with a psychological mechanism; Time preference. Time preference is an economic term synonymous with psychological constructs such as delay of gratification, risk taking and impulsivity (Chisholm, 1999a). According to Chisholm, those who accelerate their reproductive schedule have adopted an internal working model that is geared more towards short-term consumption over long-term investment ("A bird in hand is worth two in the bush"). He argued that, in high mortality environments, investing all resources in only a few offspring invites the potential for extinction. An uncontrollable mortality event (such as a prolonged famine) may eliminate all offspring, thus removing the parents' genes from the gene pool. In this ecological context, it is rational to consume resources and exploit opportunities now as opposed to saving them for future use. Expending resources to avoid fitness cliffs in the immediate future is always more reproductively advantageous as death equates to lineage extinction. The rational response is therefore to hasten reproductive onset (lengthening overall reproductive windows) and to mate frequently to ensure at least one offspring survives to the next generation. Those in more stable and safe rearing environments adopt the opposite pattern of behaviour. When mortality is lower, short-term consumption is not advantageous. Resources can be invested for the future to allow bigger fitness returns when offspring develop. Delaying reproduction and having fewer offspring allows a greater opportunity to invest in developing offspring, enabling them to be better equipped to deal with environmental/competition issues in later life. The cognitive mechanisms that direct these reproductive decisions are therefore sensitive to risks occurring in the rearing environment and respond to mortality threat by orienting an individual towards the present. Time preference is therefore an important psychological component of psychosocial acceleration theory. There is evidence supporting Chisholm's claims, with research demonstrating that those in poorer environments have a weaker orientation towards the future and show weaker self-regulatory abilities (Evans & English, 2002; Lengua, 2002). Concepts pertaining to time preference (such as time perspective) also appear to show expected relationships with life history outcomes (Kruger, Reischl & Zimmerman, 2008; Schechter & Francis, 2010). Furthermore, proxies for time perspective (such as life expectancy) also demonstrate the same relationships (Chisholm, 1999b; Daly & Wilson, 1997; Hill, Ross & Low, 1997). The specifics of time preference will be addressed in Chapter Three.

1.4.2.3. The role of attachment and sex differences

Whilst attachment will be referred to throughout this thesis, the research reported here will not focus directly upon this topic. It is important to explain how the attachment framework fits into the mechanisms that drive strategy development and how biological sex has been tied to it.

In Belsky et al.'s (1991) original model, attachment was conceptualised as a secure/insecure dimension for the sake of parsimony, with faster strategies emerging from greater insecurity. Bowlby (1969) claimed that children use attachment to the mother figure as a means to gather information about their environment. As they develop and become more explorative, they begin to make predictions regarding the future, which are used to inform future trade-offs (Chisholm, 1999a). Development is the precursor to reproduction and must occur before reproduction is viable. Chisholm claimed therefore that developmental strategies were in fact incipient reproductive strategies. The security afforded by the attachment bond would be embodied into the developing child's internal working model (IWM) and would shape their future. The attachment bond is important because, to infants and young children, the reproductive strategy of their parents is likely the most important feature of their developing environment (Belsky et al., 1991; Chisholm, 1993; 1999a; 1999b; Draper & Harpending, 1982). Parental investment would have been the most reliable indices of resource availability. The IWMs that form (thus embodying the developmental environment) guide future resource allocation throughout the individual's developmental trajectory. Attachment style and IWMs are also thought to be at least moderately stable constructs (Fraley, 2002) that persist throughout the lifespan, particularly for those with stable attachment styles (Waters, Weinfield & Hamilton, 2000). Belsky (2005) also showed that adult attachment styles were reliably associated with the styles of their offspring (see also Fonagy, 1996). The IWM is therefore likely to have an effect across the lifespan and exert a continual influence on life history strategy. However, that is not to say that attachment patterns are immutable. Stability of attachment is strongly linked to stability of life stressors; life events and relational changes can alter attachment patterns, particularly between childhood and early adulthood (Bretherton & Munholland, 1999; Waters et al., 2000; Weinfield, 2000). As in most behavioural domains, the attachment mechanism does appear to have some capacity for plasticity.

Chisholm (1996) made specific predictions regarding the type of attachment bond and the incipient future reproductive strategy of the developing child. Securely-attached parents show long-term parental investment, warmth and responsiveness to their child. The child uses the secure base to maximise learning and development from willing parents and matures slowly. Insecure attachment takes multiple forms, the most accepted in the literature being avoidant and ambivalent (Ainsworth, Blehar, Waters & Wall, 1978). Avoidant parents are unwilling to invest, are dismissive of children and preoccupied with their own mating effort. Children therefore aim to maximise survival and are fearful of potential abandonment or infanticide, fostering avoidance behaviour. Ambivalent parents tend to be unable to invest due to resource shortfalls and are inconsistent in investment strategies but are not necessarily rejecting of their children. Infants maintain investment from their parents but mature and reproduce more quickly. This dual classification of insecure attachment allows the emergence of a greater diversity of life history strategies and encompasses more of the individual differences observed in key variables such as pubertal onset, reproductive onset and other life history traits. Belsky (1997) comprehensively reviewed data from measures such as the strange situation (Ainsworth &

Wittig, 1969), the adult attachment interview (Main & Goldwyn, 1998) and psychometric attachment measures and concluded the distinction between avoidant and ambivalent attachment styles was consistent with Chisholm's original conceptualization and that these attachment styles fostered adaptive behavioural strategies in their own right.

Del Giudice (2009a) advanced this idea further and suggested that the attachment patterns that emerged in middle childhood had adaptive significance throughout the lifespan and were part of coordinated, sex-specific developmental pathways. Belsky et al. (1991) make little reference to biological sex, and the original connotations of psychosocial acceleration theory did not explicitly deal with sex differences. Chisholm, (1999a) however did make some suggestion that the sexes differ in their life history trajectories. Building on sexual selection and parental investment theory, Chisholm claimed that insecurity in males would lead to what Wilson and Daly (1985) called 'young male syndrome'; a strategy characterized by risk taking, impulsiveness, aggression and increased mating effort. Parallel to this, Chisholm claimed that women would adopt a 'young female syndrome', characterised by fast maturity, impulsive mate choice and single motherhood. Both of these conceptualizations are consistent with the earlier models of Belsky et al. (although not framed so explicitly in these works). Del Giudice (2009a) reviewed evidence to suggest that boys and girls differ in their attachment styles in middle childhood. He argued that insecure males are more likely to adopt avoidant strategies than ambivalent styles, whilst females adopted the opposite pattern. Based on the asymmetries in parental investment and sexual selection (noted earlier), males and females are unlikely to have identical life history trajectories. Del Giudice theorised that it was adaptive for males to adopt avoidant patterns as this often fosters heightened aggression and dominance behaviour: pertinent to competition and attractive to females. Avoidant patterns in males also allow them to pursue mating-based strategies and avoid investment commitments. Females however use a strategy of ambivalence to maximise investment from mates and extended kin. Del Giudice's argument is consistent with Chisholm's young male/female syndromes. However, beyond these initial proposals, sex is rarely examined in relation to life history strategy development in current research.

5.0. Aims of the current thesis

Psychosocial acceleration theory can be conceptualised broadly as in Figure 1. Environmental cues cause parental stress and a general deterioration in family functioning. This stress is embodied by developing children indirectly via the formation of the attachment bond. The attachment bond facilitates the development of an internal working model that conveys information to the child that life will be shorter. Time preferences become orientated towards short-term consumption over long-term investment. Developmental milestones (such as puberty) are reached earlier and behaviour shifts towards exploitation over investment, causing a greater likelihood of violence, short-term mating, early sexual onset and other behaviours akin to faster strategies. It should be noted that Figure 1 is a simplified version of the model and, in reality (as Belsky et al., 1991 highlight) the chain of events is unlikely to be purely linear and is more akin to a "cumulative-conditional-probability conceptualization" (pp. 650). In such a model (and although impossible to specify given the current body of research literature), different contextual conditions may differentially weight the influence of proximal and distal causes of strategy related behaviour.

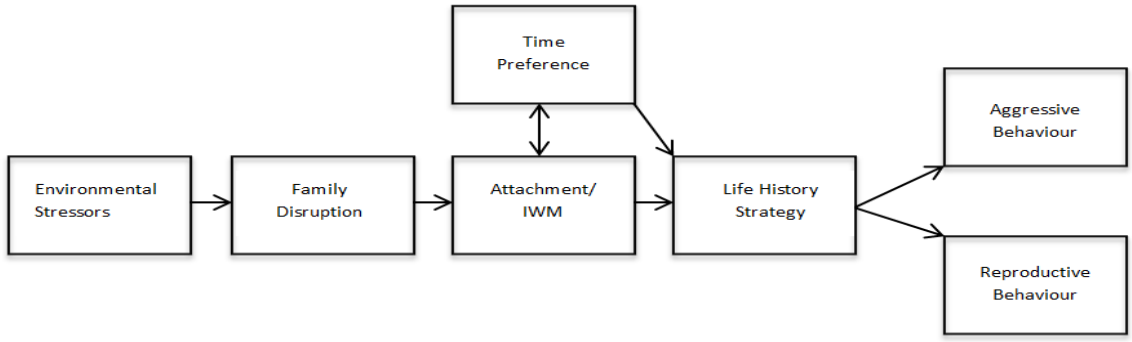

Figure 1: A representation of psychosocial acceleration theory

As demonstrated so far, psychosocial acceleration theory and life history strategies have received much empirical support. Although most studies focus on particular aspects of the overall model, some attempts have been made to map longitudinally the development strategies in humans (see Belsky, Schlomer & Ellis, 2012; Simpson, Griskevicius & Kuo, 2012). Significant questions remain however regarding many of the details of this model. Firstly, how should life history strategies be measured and what are the issues surrounding recent attempts to assess them? Secondly, how precisely does the environment bring about strategy development and what particular factors are pertinent? This area has been left largely unspecified in early versions of the psychosocial acceleration theory. Thirdly, what is time preference, how does it work as a mechanism and which personality or behavioural traits are encompassed within it? This particular construct has been left conceptually underspecified in the literature but is frequently invoked as an explanatory variable (often inconsistently). Finally, how is biological sex implicated in the development of strategies? Almost all of the key variables (behaviours and variables encompassed by time preference) show clear sex differences. Sex differences or sex-specific effects and models are seldom tested in life history research however, leaving this crucial individual difference variable largely unexplored. This thesis aims to clarify these underlying issues, and in doing so, evaluate the key phases of psychosocial acceleration theory. How this is to be achieved is specified below.

In Chapter Two, potential measurement strategies implemented in studies of life history theory are explored. Paper One argues that psychosocial acceleration theory should be examined from an evolutionary developmental perspective as opposed to the use of global psychometric strategy-based indicators. This chapter then outlines the research perspective that underpins the remainder of the thesis.

In Chapter Three, the role of the environment is examined empirically in Paper Two and validated in Paper Three. This chapter argues that environmental variables do not just have effects through the attachment process and that these factors have direct effects on multiple levels, including personality and behaviour. Clarification of potential environmental stressors is also examined in more detail.

In Chapter Four, the role of time preference is examined; what is it and how the concept should be defined. This chapter evaluates its interaction with the key variables that Chisholm considers crucial to strategy development and the efficacy of a global trait that directs individual interpretation of future investments. These

issues are investigated in Papers Four, Five and Six. The chapter argues that a global mechanism is not viable and identifies which particular psychological traits are related to life history strategy based behaviour.

Chapter Five tests the model on a cohort of developing adolescents to determine if the psychosocial acceleration model works as hypothesised. Paper Seven uses structural equation modelling to validate the model and bring the main findings of this body of research together in one analysis. A supplementary analysis focussing on differences in gender pathways follows.

Chapter Six is a general discussion that evaluates the work presented in this thesis from a holistic perspective of psychosocial acceleration. It addresses recent challenges, suggests potential improvements and identifies additional avenues for research.

CHAPTER 2

Perspectives on Life History Strategies

2.1. Introduction

This chapter examines approaches to life history research and details differences between 'Differential-K' (Rushton, 1985) and psychosocial acceleration theory (Belsky et al., 1991) in their approach to human life histories. In Paper One[1], this discussion begins with an empirical analysis and critical review of psychometric measures (the key methodology employed by proponents of Differential-K) before expanding upon issues highlighted in this paper to detail the approach of this thesis in evaluating psychosocial acceleration theory.

Belsky et al's (1991) proposals (reviewed in Chapter One) stimulated a synthesis of developmental and evolutionary thinking to produce a new perspective on child development (Belsky, 2014; Ellis et al., 2012). The application of life history theory to human behaviour however had earlier origins based on r/K theory; a perspective referred to as Differential-K (Rushton, 1985). Although Differential-K and psychosocial development theory share many commonalities, they demonstrate important conceptual differences.

Proponents of Differential-K theory (Rushton, 1985) draw heavily from traditional r/K selection work on non-human species (MacArthur & Wilson, 1967; Pianka, 1970), extrapolating these principles to human variation. As Paper One will highlight, despite conceptual and empirical problems with the r/K continuum (Promislow & Harvey, 1991; Stearns, 1992), the idea has persisted and measures based on the overarching principle of a higher-order factor orchestrating human development are still popular (Bogeart & Rushton, 1989, Giosan, 2006; Figueredo et al., 2006).

The Differential-K continuum encompasses virtually all domains of human behaviour, from reproductive strategy through to personality, social behaviour, intelligence and risk taking amongst other things. As such, proponents of Differential-K examine how coordinated trait clusters work in unison to facilitate adaptive functioning and do not advocate modular approaches to individual trait functions in the tradition of evolutionary psychologists. This view of personality as domain-general means that Differential-K researchers examine higher-order constructs rather than individual traits, behaviours or outcomes. As Paper One and the remainder of this chapter will highlight, this creates conceptual problems, particularly where causality is concerned.

[1] Copping, L.T., & Campbell, A.C., & Muncer, S. (2014). Psychometrics and life history strategy: The structure and validity of the High K Strategy Scale. *Evolutionary Psychology*, 12, 200-222.

Psychometrics and Life History Strategy: The Structure and Validity of the High K Strategy Scale

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Abstract: In this paper, we critically review the conceptualization and implementation of psychological measures of life history strategy associated with Differential-K theory. The High K Strategy Scale (HKSS: Giosan, 2006) was distributed to a large British sample (N=809) with the aim of assessing its factor structure and construct validity in relation to theoretically relevant life history variables: age of puberty, age of first sexual encounter and number of sexual partners. Exploratory and confirmatory factor analyses indicated that the HKSS in its current form did not show an adequate statistical fit to the data. Modifications to improve fit indicated four correlated factors (Personal Capital, Environmental Stability, Environmental Security, Social Capital). Later puberty in women was positively associated with measures of the Environment and Personal Capital. Among men, contrary to Differential-K predictions but in line with female mate preferences, earlier sexual debut and more sexual partners were positively associated with more favourable Environments and higher Personal and Social Capital. We raise concerns about the use of psychometric indicators of lifestyle and personality as proxies for life history strategy where they have not been validated against objective measures derived from contemporary life history theory and where their status as causes, mediators or correlates has not been investigated.

Keywords: K-Strategy, life history, puberty, sex differences, psychometric analysis

Introduction

The use of psychometric indicators by evolutionary psychologists to investigate life history strategies in human populations has increased dramatically over the last decade. This study examines one such measure of life history (High-K Strategy Scale - HKSS, Giosan, 2006) and its relationship to theoretically related traits in a large British sample as well as reviewing this growing field in general.

Life History Theory

Life history theory (LHT) is an explanatory framework grounded in the evolutionary sciences, describing how and why variation in phenotypes emerges between species and how phenotypic variation translates into variation in fitness (Stearns, 1992). Phenotypic variation is constrained however, principally by trade-offs between traits (Roff, 1992). Organisms within an ecological niche invest finite resources in various traits to optimise fitness returns (thus maintaining genetic survival in future generations). Investment in one trait

can entail costs for another trait. There are many trade-offs during the developmental lifespan of an organism; perhaps the most important determines the developmental switch from growth to reproduction (Charnov, 1993; Stearns, 1992), which Schaffer (1983) calls the General Life History problem. Organisms can invest in somatic effort and delay reproduction (favouring growth and health at the expense of a shorter reproductive career) or the reverse (favouring early, rapid reproduction at the expense of offspring health and quality).

Life History Theory and Evolutionary Psychology

Whilst LHT originally examined variation across species, it has been applied to variation within species by behavioural ecologists and to variation within human traits by human behavioural ecologists and evolutionary psychologists. Rushton, (1985) attempted to map key human life history traits, based on earlier work by Pianka (1970), across what was originally termed the r/K continuum which posits that species exist along a continuum of fast to slow development. A species towards the r side of the spectrum develops very quickly, maturing early, reproducing quickly and producing as many offspring as possible due to low levels of competition for resources. As population density increases and resources become increasingly finite, development slows and investment moves towards ensuring a small number of reproductively fit individuals survive to reproduce. More resources are invested in fewer offspring to increase their competitive advantage in securing resources for future survival. *Homo sapiens*, under this classification, are considered to be a K-selected species, with slow development, long gestation periods and relatively small numbers of offspring.

Whilst the r/K continuum initially received a great deal of interest, contemporary life history theorists now reject this concept (Stearns, 1992). Initial theory was based on density-dependent habitats which, when modelled, failed to predict life history strategies in almost 50% of species. More recent research highlights instead the importance of local age-specific mortality rates in relation to density in ecological conditions (Charlesworth, 1980; Charnov & Berrigan, 1990; Promislow & Harvey, 1990; Stearns, 1992), with age specific models being generally more accurate in mapping strategies in artificial selection experiments (Barclay & Gregor, 1981; Luckinbill, 1979; Taylor & Condra, 1980).

Although the r/K dimension is no longer accepted in its entirety, the existence of heritable clusters of morphological and behavioural traits persists in evolutionary psychology. This idea has been prominently expressed in Rushton's (1985) 'Differential-K' theory which proposes individual (and racial) differences in psychological traits associated with an individual's position on the K spectrum. The last two decades has seen a multitude of attempts to examine these psychometrically (Bogeart & Rushton, 1989; Figueredo, Cabeza de Baca & Woodley, 2013).

Evidence of this hypothesised behavioural clustering in humans has begun to emerge through such studies. Figueredo, Vasquez, Brumbach and Schneider (2004) identified traits believed associated with life history strategy that load onto a single "K-Factor" including attachment (childhood and adult); mating effort; Machiavellianism; and risk propensity. Figueredo, Vasquez, Brumbach and Schneider (2007), in a large American sample, found a similar latent construct composed of twenty measures such as family relationships, altruism, kin support, religiosity and financial status. Furthermore, this construct loaded onto a single higher order factor together with latent variables of personality (built from measures of Agreeableness,

Conscientiousness, Openness, Extraversion and Neuroticism) and general health ("covitality" measured with indicators of psychological and physical wellbeing). This higher-order factor, called the "Super-K", was taken as evidence that life history strategies represent a coordinated range of physical, cognitive and behavioural traits that coexist throughout the lifespan. Research suggests that the "K-Factor" may also be heritable (Figueredo, Vasquez, Brumbach & Schneider, 2004).

Research has continued with the development of scales that purport to measure life history traits. The two most prominent measures are the Arizona Life History Battery (ALHB: Figueredo et al., 2004) and its shorter equivalent, the Mini-K scale (Figueredo, et al., 2006). These measures have been reported to be related to a number of variables argued to be associated, positively or negatively, with a K lifestyle including aggression and anti-sociality; sociosexuality; religiosity; the 'Dark Triad' (a clustering of three personality facets: psychopathy, narcissism and Machiavellianism); relationship satisfaction; and the use of sexual coercion (Figueredo et al., 2013; Gladden, Sisco, & Figeuredo, 2008; Gladden, Welch, Figueredo & Jacobs, 2009; Jonason, Koenig & Tost, 2010; McDonald, Donnellan & Navarrete, 2012; Olderbak & Figueredo, 2010).

An alternative measure of life history strategy is the High-K Strategy Scale (HKSS: Giosan, 2006). Whereas the ALHB and Mini-K focus on behavioural and cognitive aspects of life history, the HKSS was originally intended to focus on fitness which was "largely referred to as overall adaptedness" (Giosan, 2006 pp. 394). This scale has received less attention in the empirical literature with only twelve published studies to date. The present study sought to evaluate the HKSS in terms of its theoretical suitability in relation to assessing life history strategy.

The structure of the HKSS

The HKSS was designed to assess facets of social life that reflect the adoption of an underlying High-K strategy. Giosan (2006) constructed an initial 26 item scale focusing on four domains: 1) health and attractiveness, 2) upward mobility, 3) social capital and extended family and 4) consideration of risks. These domains were selected because K strategists are expected to: demonstrate a proclivity to invest in somatic effort (which should translate into better health and longevity), achieve greater degrees of upward mobility and access to superior opportunities (enhancing offspring competitiveness), foster strong kin networks (to increase fitness returns from their own offspring and those of relatives); and channel resources to be more risk aversive (positively affecting fitness). The 26 items were selected on the basis of face validity. Internal consistency of the scale appears high, studies typically reporting alpha values between .81 and .94 (Dunkel & Decker, 2010; Dunkel, 2012).

However, there is a lack of information on the underlying factor structure. We do not currently know whether these four domains have been accurately measured, or whether the domains are (1) related to each other and (2) load onto a single latent factor akin to a "K-Factor". Dunkel, Mathes and Harbke (2011) reported that the total scores from the HKSS and the Mini-K load onto one latent "Life History" factor which accounted for 53% of the variance. However, because the HKSS was part of a larger model constructed from scale totals rather than individual items, no information regarding the internal structure of the HKSS exists.

HKSS and construct validity

Giosan (2006) reported that scores on the HKSS were significantly and positively related to higher perceived offspring quality; fewer medical problems; better education; more social support; and fewer previous marriages. Surprisingly, High-K scores correlated positively and significantly (albeit, weakly) with number of offspring, contrary to predictions from Differential-K theory (K-selection should favour quality, not quantity). Giosan and Wyka (2009) also reported that High-K scores were negatively related to instances of psychopathology, anger expression and sleep disturbance and positively with likelihood of marriage. Research using the HKSS has also reported significant positive correlations with estimated life expectancy, future time perspective, long term mating orientation, and the general factor of personality (Dunkel & Decker, 2010; Dunkel, Kim & Papini, 2011). Furthermore, the HKSS appears to be positively and moderately correlated (as highly as $r = .67$) with the Mini-K, another measure of life history (Abed et al., 2012; Dunkel & Decker, 2010; Dunkel, et al., 2012; Dunkel, et al., 2011; Gladden et al., 2009; Olderbak, Gladden, Wolf & Figueredo, 2014).

HKSS and sampling issues

Sampling in relation to HKSS research is a concern. Of the twelve published studies that use the HKSS, only one appears to have used a general population from the U.S.A. (Dunkel, et al., 2011). The majority used college samples (Abed et al., 2012; Dunkel & Decker 2010; Dunkel et al., 2012; ; Gladden et al., 2009; McDonald et al., 2012; Olderbak et al., 2014) whilst others (Giosan, 2006; Giosan, 2013; Giosan & Wyka, 2009) used specific samples (such as disaster workers or utility company employees). The utility of this scale as a measure of life history strategy is difficult to determine without a large and representative sample of the general population. Samples used in recent works are almost exclusively from the United States and so cross cultural validity is lacking. This concern about sampling is also true of other research using psychometric indicators of life history strategy. A more general critique of psychometric indicators of strategy follows.

General issues with psychometric life history indicators

Whilst there are issues specific to the HKSS, there are more general concerns regarding psychometric life history measures that warrant consideration. Firstly, sex differences are rarely considered. Although Dunkel (2012) and McDonald et al. (2012) report sex differences on the HKSS with females scoring higher than males, these effects have not been examined outside of the U.S. Furthermore, a considerable body of research has identified sex differences predicted by evolutionary theory and has outlined sex-specific developmental trajectories (Bailey, Gaulin, Agyei & Gladue, 1994; Del Giudice, 2009; Del Giudice & Belsky, 2010). Differences in behaviour between the sexes are explicable in terms of differential investment in parenting versus mating activity (Bateman, 1948; Trivers 1972; Campbell, 1999; Daly & Wilson, 1983). Measures such as the HKSS and the Mini-K that assume a single aggregate 'fitness' continuum common to both sexes are therefore unlikely to be useful if the often competing goals and strategies of men and women are ignored (Muncer, 2013).

LHT originally examined objective, biological events across species (growth rate, offspring number, body sizes; see Pianka, 1970 for examples). Recent examinations of K-strategies in humans use inventories focusing mainly on personality and attitudes (such as impulsivity, altruism, attitudes to relationships,

Machiavellianism and planning). The General Personality Factor, for example, is a single factor derived from the Big Five traits that is argued to represent a K-adapted personality constellation (Rushton & Irwing, 2008) and the theoretical existence of such a higher order concept was one of the driving factors in Differential-K research (Rushton, 1985). Inventories such as Mini-K, ALHB and HKSS focus on lifestyle (such as religiosity, wellbeing, social support and community engagement) consistent with a hypothesised "K-oriented" lifestyle. It is difficult to establish how well these personality and lifestyle variables independently measure an individual's strategy without first validating them against objective life history events. Measures of current wellbeing, integration into the community and perceived neighbourhood safety tell us little about how they would contingently translate into fitness returns. If the HKSS, ALHB or Mini-K are adequate reflections of an individual's strategy, high scale scores should correlate with critical developmental events such as a later pubertal onset, delayed sexual onset and fewer lifetime sexual partners. Yet these crucial variables are rarely tested in relation to psychometric life history indicators. Considering that these indicators of strategy form some of the key foundations of LHT, examining their relationship to outcomes should be a research imperative for validation purposes. A recent review of psychometric measures of life history strategy (Olderbak, Gladden, Wolf & Figueredo, 2014) indicates that measures of mating effort (an important trade off with parenting effort) do not significantly correlate with the HKSS, the ALHB or the mini-K. If such measures are not associated with life history outcomes that potentially impact on fitness, it raises questions as to how they can represent independent measures of fitness.

Furthermore, such inventories contain a blend of items assessing current and past environments, relationships with parents and offspring, personality and lifestyle. This eclectic assortment is particularly problematic for those who approach life history research from a psychosocial acceleration position (e.g. Belsky, et al., 1991, Chisholm, 1999, Hill, Ross & Low, 1997). This proposes that early experiences, particularly environmental stress, result in changes to cognition and affect which subsequently modulate fitness-relevant behaviours. In many inventories, factors which are proposed to canalise developmental strategy (early environment and relationships) are confounded with potential mediators of strategy (cognition, affect, personality) and with LH outcomes and correlates (e.g. relationship stability, risk taking). Important contingent relationships are thus ignored and such measures often appear to examine what the current environment is like rather than how the individuals respond to the environment in which they developed.

Many items on these instruments, as mentioned earlier, appear to be indicators of comfort, security, community engagement and related aspects of 'lifestyle'. High-K strategists are expected to score in a manner suggestive of greater security, comfort and community cohesion. These items however may simply be indications of socioeconomic status as opposed to life history strategy. There is a danger in equating a middle-class lifestyle with optimal fitness, contrary to original life history proposals that 'fast' and 'slow' trajectories are equally adaptive but to different ecological niches. Few studies using psychometric indicators of life history strategy examine social class differences. The two that do (Figueredo et al., 2004, 2007) reported very small effects on the ALHB. Because these earlier studies suggested no class effects, later replications have not examined it further. No such test for social class differences has been conducted on the HKSS.

Current study

The current study aimed to examine the HKSS with a large, general sample from the United Kingdom and to (1) examine the underlying factor structure of the measure and (2) to critically examine its relationship to theoretically relevant life history variables and review findings in relation to the current evolutionary literature.

Materials and Methods

Participants

Data was taken from a national survey conducted in England in 2011. English participants were recruited to take part in an online questionnaire by a market research company as part of a survey commissioned by a national newspaper. Participants had to be between ages 25 and 55 to participate. 1004 responses were collected and, of these, 809 answered the key life history questions of interest. The usable sample consisted of 383 females and 426 males with a mean age of 39.11 (SD=8.83). Table 1 presents descriptive characteristics of the sample. Whilst the sample aimed to be as cross-sectional as possible, it must be noted that participants were, by nature of recruitment, literate newspaper readers. Social class is also weighted more heavily in the higher classes than the lower.

Table 1: Sample Characteristics

		N	%			N	%
Gender	Males	426	52.7	Location	North	248	30.7
	Females	383	47.3		Midlands	253	31.3
Children	With Children	459	56.7		South	303	37.5
	No Children	350	43.3		Not Specified	5	0.6
Sexual Orientation	Heterosexual	732	90.5	Social Class	A	102	12.6
	Homosexual	30	3.7		B	299	39
	Bisexual	38	4.7		C1	260	32.1
	Not Specified	9	1.1		C2	63	7.8
Marital Status	Single	134	16.6		D	25	3.1
	Relationship	223	27.7		E	33	4.1
	Married	397	50		Not Specified	27	3.3
	Divorced	50	6.2	Mean age	Males	40.4 Years	
	Widowed	5	0.6		Females	37.7 Years	

Measures

Life history strategy: Life history strategy was measured using the HKSS (Giosan, 2006). This measure consists of 26 five-point Likert scale items measuring fitness outcomes. (Items can be seen in Table 3.) A higher score indicates a greater orientation towards K strategies. Internal consistency of the scale in this study was high with α = .86.

Age of Puberty: Participants were asked to indicate how old they were when they reached puberty. The response options (and their coding) were as follows: Age 11 or younger (1); age 12 (2); age 13 (3); age 14 (4); age 15 (5); age 16 or above (6).

Age of First Sex: Participants were asked to indicate their age in years when they first engaged in sexual intercourse.

Number of Sexual Partners: Participants were asked to indicate the number of people with whom they had had sexual intercourse in their lifetime. The response options and their coding were as follows: No sexual partners (1); 1 sexual partner (2); between 2 and 10 sexual partners (3); between 11 and 20 sexual partners (4); between 21 and 50 sexual partners (5); between 51 and 100 sexual partners (6); More than 100 sexual partners (7). Given that older participants were likely to have had more sexual partners, it was necessary to control for age. This was done by subtracting *Age of Puberty* from chronological age to give an indication of reproductive lifespan in years. The reported number of sexual partners was divided by reproductive lifespan to give an indication of the rate of partners per year. As the number of sexual partners was recorded categorically, the lower bound number in each category was used for the basis of calculation.

Social Class: Participants social class was indexed by the National Readership Survey System (2011). Participants indicated which social class they belonged to from a choice of six categories based on their occupation (A, B, C1, C2, D, E with A representing upper middle class and E representing those at the lowest level of subsistence). A, B and C1 are grouped as *Middle Class* and C2, D and E are grouped as *Working Class* for the purpose of analysis. Table 1 provides a numerical breakdown of the class responses. The sample was biased towards the *Middle Class* in this study, the *Working Class* representing only 15% of the sample.

Analysis was conducted using IBM Statistics SPPS (Version 19). Confirmatory Factor Analysis (CFA) was performed using AMOS (Version 19). Where the HKSS had missing cases, the series mean was used for the purposes of analysis. It was quickly apparent that the most frequently omitted questions pertained to children. Questions specific to children and marriage had response rates of less than 90%, as did items about living with a partner. Dunkel and Decker (2010) recommended that the latter items should be removed from some samples (notably college samples). One further item (I have good health insurance benefits) also had a high rate of omission. Due to the National Health Service in England, less than 16% of the population pay for private health insurance. All items with responses less than 95% complete were omitted. Nineteen of the 26 items were used for further analysis.

Results

Confirmatory Factor Analysis (CFA) was conducted on the entire sample to determine if the structure hypothesised by Giosan (2006) represents an adequate statistical fit to the data set. The hypothesised association between items and factors, not available in published papers, was supplied by Giosan (personal communication, April 2013) and is illustrated in Figure 1. All statistics for the models tested in this section are numbered 1 to 7 and provided in Table 2 for ease of comparison.

Models comparisons were conducted using a variety of fit statistics. Chi-square tests evaluate the significance of differences between the restricted and unrestricted sample covariance matrix. The CFI (Comparative Fit Index) compares the similarities between the model's covariance matrix and the matrix observed in the data. The Root Mean Square Error of Approximation (RMSEA) examines overall model complexity. CFI values should be greater than .90 and RMSEA values should be at least between .05 and .08 to demonstrate an adequate fit (Brown & Cudeck, 1993; Steiger, 1989).

Model 1 was constructed using four latent variables (representing each of the four hypothesised subscales) loading onto one super factor as depicted in Figure 2. Results show that this structure did not adequately fit the data set.

Table 2: Model Comparisons

Model	**N**	**X^2**	**DF**	**X^2/DF**	**P**	**RMSEA**	**CFI**
(1) HKSS (Giosan 2006)	809	1123.02	148	7.59	***	.090	.75
(2) HKSS (Giosan 2006: Four Correlated Factors)	809	1089.12	146	7.46	***	.089	.76
(3) HKSS (Giosan 2006: Unidimensional)	809	1369.23	152	9.01	***	.100	.69
(4) HKSS (PAF Based)$^{\Omega}$	404	537.31	148	3.63	***	.080	.79
(5) HKSS (PAF Based: Four Correlated Factors)	404	487.45	146	3.34	***	.076	.82
(6) HKSS (Revised)$^{\Psi}$	809	379.10	134	2.83	***	.048	.91
(7) HKSS (Revised: Four Correlated Factors)$^{\Psi}$	809	315.60	133	2.37	***	.045	.94

Ω Negative Variance, Ψ validated across both samples, ***p<.001

A second model was constructed in which the super factor was replaced by four correlated subscales (Model 2), yielding an improved but still comparatively poor fit to the data. Finally, an attempt was made to remove the latent sub-factors and load items directly onto one latent HKSS factor to determine if the items represented a unidimensional construct (Model 3). This model had the poorest fit.

Attempts were made to re-specify the model. To determine the most parsimonious structure for the HKSS, the following procedure was conducted. The sample was split into two approximately equal halves. Principle axis factoring (PAF) with an oblique rotation was used to determine the factor structure of the HKSS on the first half of the sample (N=405). Table 3 illustrates the component matrix from the PAF.

A four factor solution explaining 40% of the variance in the data was found. As shown in Table 3, the underlying structure of the HKSS does not result in a single dimension, nor does it conform precisely to the four domains on which Giosan (2006) based the items. CFA was used on the remaining 404 participants to determine if this four-factor structure could fit parsimoniously to the data. A model was again created using the four scales from the PAF and a super factor (Model 4). The model resulted in negative variance and was a poor fit to the data. A model without the super factor (but leaving the four latent sub scales correlated) improves the fit significantly ($p<.001$) but is still a poor fit overall (Model 5).

Using modification indices from the CFA on the second sample, the model was re-specified (by removing items that loaded heavily onto multiple factors) in order to achieve a model that best reflected the data. The final model was constructed using 13 items on four latent sub-factors which in turn loaded onto one latent super factor as depicted in Figure 3. This model was validated on the original sample of 405 participants to reduce the likelihood of Type 1 error. In a further attempt to validate this model, all links were fixed from the original model and applied across both samples. The model was tested with a super-factor (Model 6) and without (Model 7). As can be seen in Table 2, whilst the super factor model demonstrates an adequate fit to the data, the model can be improved significantly by removing the super factor and using four correlated sub factors (X^2diff = 63.50, df diff = 1, $p < .001$). These four factors were conceptually identifiable as follows: *Personal Capital*, *Environment Stability*, *Environment Security* and *Social Capital*. Alpha values of the subscales ranged between .66 and .73. These four subscales were used for the purposes of further analysis.

HKSS and Life History variables

One aim of this study was to examine relationships between the HKSS and other key indices of life history. Correlations among these key variables are presented in Table 4. The correlations among life history variables were broadly in line with predictions. *Age of Puberty* was significantly, positively related to *Age of First Sex* (*r=.24, p<.01*) and negatively related to the *Number of Sexual Partners (r=-.10, p<.01)*. *Age of First Sex* and *Number of Sexual Partners* were negatively correlated (*r = -.23, p<.01*).

Sex differences in many of these variables were apparent (see Table 5). As expected, men reported a significantly higher *Number of Sexual Partners* and women reported significantly earlier *Age of Puberty*. As sex differences were evident, correlation analysis was repeated by sex (Table 6). Relationships between subscales were very similar for males and females. Differences emerged however in relation to life history variables. In women, *Age of Puberty* significantly positively correlated with *Environmental Stability*, *Environmental Security* and *Personal Capital* suggesting, as predicted by LHT, that more favourable life circumstances are associated with a later sexual maturation. However, neither of the remaining LHT variables was associated with the four scales in women.

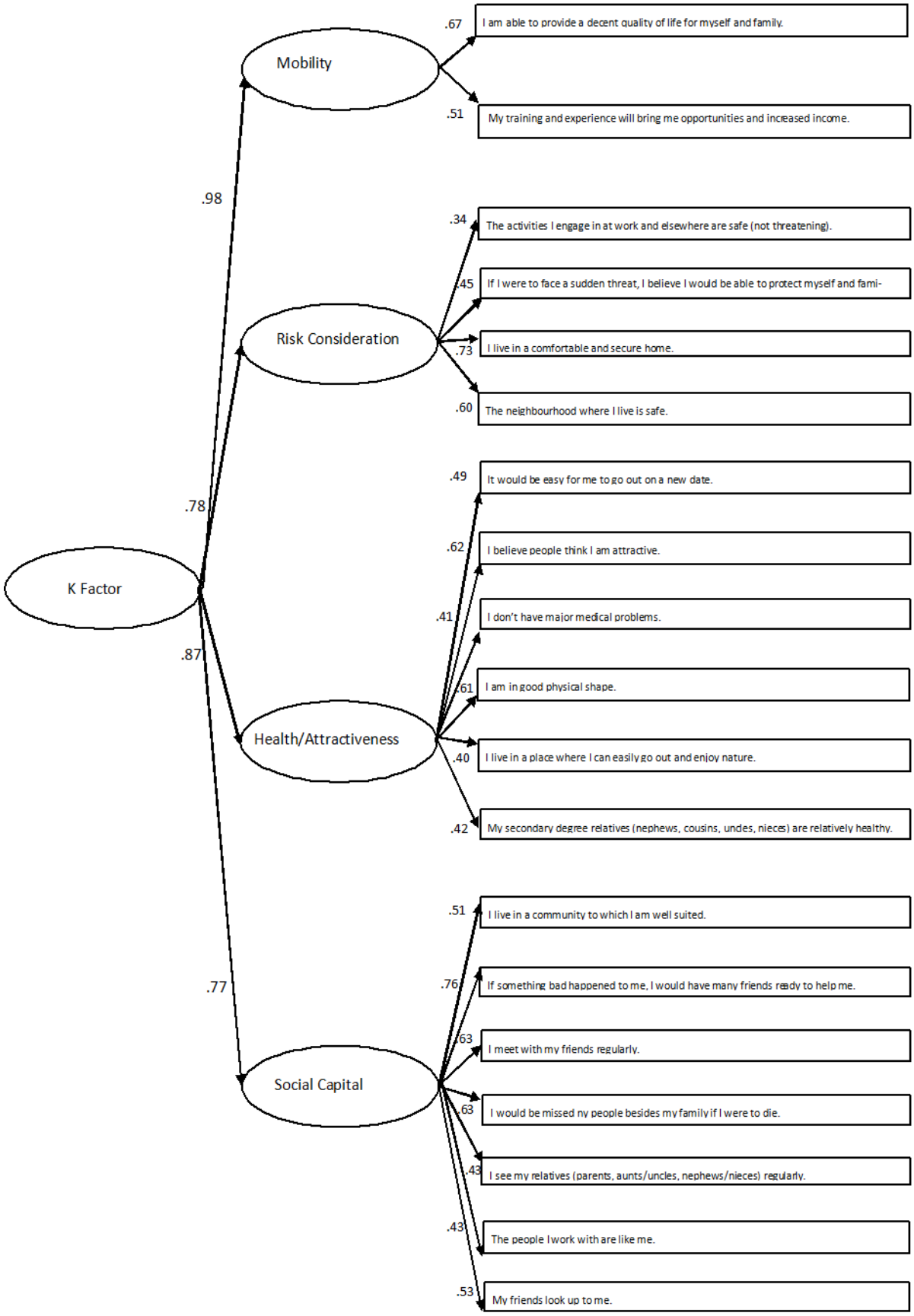

Figure 2: Original Specification (Giosan 2006)

Table 3: PAF Factor Structure of the HKSS items

Item	1	2	3	4
If I wanted to, it would be easy for me to find and go on a new date	**0.78**	-0.13	-0.07	0.06
I believe people think I am attractive	**0.72**	-0.02	-0.10	0.18
My friends look up to me	**0.52**	0.06	-0.32	-0.08
My training and experience are likely to bring me opportunities for promotion and increased income in the future	**0.42**	0.22	-0.20	-0.09
I live in a comfortable and secure home	0.05	**0.78**	0.03	0.01
The neighbourhood where I live is safe	-0.09	**0.77**	0.03	0.04
I live in a place where I can easily go outside and enjoy nature	-0.03	**0.68**	0.02	0.02
I live in a community to which I am well suited	0.08	**0.61**	-0.17	-0.01
I am able to provide a decent quality of life for myself and my family	0.42	**0.56**	0.06	0.05
The activities I engage in, both at work and elsewhere, are safe (not life threatening)	-0.25	**0.39**	-0.18	0.08
If I were to face a sudden threat (e.g., flood, fire), I believe I would have the ability to protect myself and my family	0.34	**0.35**	0.07	0.10
If something bad happened to me, I'd have many friends ready to help me	0.13	0.00	**-0.75**	0.01
I meet with my friends regularly	0.09	-0.06	**-0.73**	0.08
I would be missed by people, besides my family, if I were to die	0.05	-0.01	**-0.67**	0.10
I see my relatives (for example, parents, uncles/aunts, nephews/nieces, etc.) regularly	-0.02	-0.10	**-0.66**	-0.02
The people I work with are like me	0.03	0.24	**-0.43**	-0.13
My second-degree relatives (nephews, cousins, uncles, nieces) are generally healthy	-0.09	0.20	**-0.42**	0.16
I don't have major medical problems	-0.12	0.02	-0.06	**0.87**
I am in good physical shape	0.27	0.02	-0.02	**0.76**

For men, *Age of First Sex* was significantly negatively correlated with three of the four revised HKSS sub-scales (*Environmental Stability, Personal Capital and Social Capital*) although *Environmental Security* was

positively correlated. *Number of Sexual Partners* was also positively correlated with *Environmental Stability*, *Personal and Social Capital*. Hence, men who scored higher on these measures had sex earlier in life with more sexual partners (after age adjustment).

Table 4: Correlations between HKSS scale scores and life history variables

Variable	Age of Puberty	Age of First Sex	Number of Sexual Partners
Personal Capital	.07	-.14**	.15**
Environmental Stability	.06	-.06	.06
Environmental Security	.03	-.04	-.01
Social Capital	-.05	-.10**	.05
Revised HKSS Total	.03	-.12**	.09*
Original HKSS Total	.03	-.09**	.06

*p<.05, **p<.01

Social class effects

For the revised HKSS, significant class differences emerged in scores for *Environment Stability* (DF (1,780), F = 14.72, p<.001) and *Environmental Security*, (DF (1, 780), F = 8.92, p<.01) with middle class individuals scoring higher than lower class individuals. However when social class was controlled, partial correlations between the scales and life history measures did not significantly differ from zero-order correlations (p>.05) in all cases for males and females (Table 7).

Discussion

It appears that the original HKSS items are best represented as four distinct but related dimensions and it can be concluded that it does not represent a unidimensional construct. This conclusion is reinforced by relationships between HKSS total scores and life history measures: The significant correlations that were found were contrary to the predictions made by the Differential-K literature (Rushton, 1985; Figueredo et al., 2012). We found that high K scores were related to earlier sexual debut and unrelated to pubertal onset or number of sexual partners. This suggests that the HKSS does not reflect an underlying "K dimension".

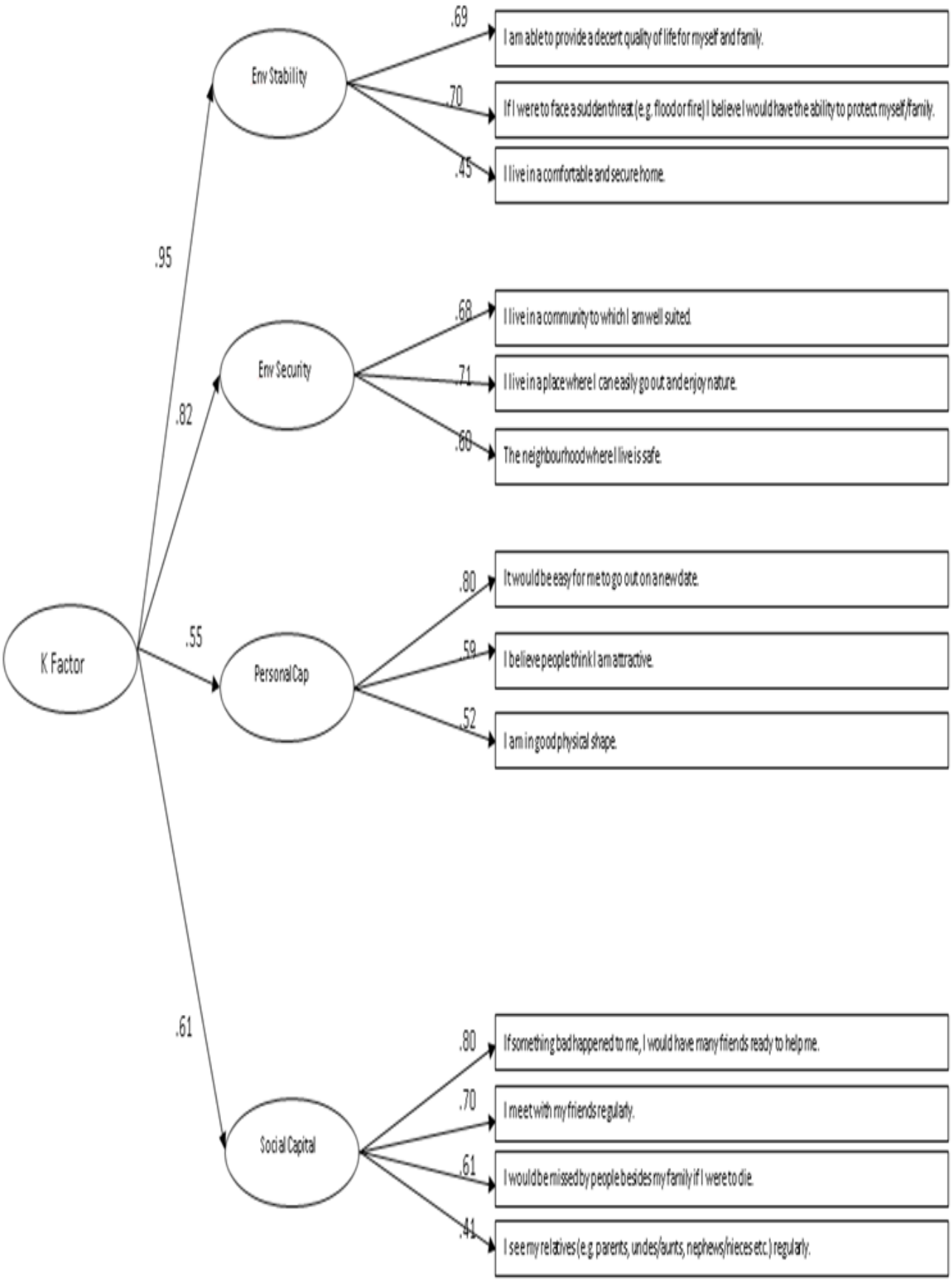

Figure 3: Modified HKSS Model

Table 5: Descriptive statistics for all variables (N = 809)

Variable	Whole sample Mean/(SD)	Men (N = 426) Mean/(SD)	Women (N = 383) Mean/(SD)
Age of Puberty Ω **	3.11 (1.31)	3.33 (1.25)	2.86 (1.33)
Age of First Sex	17.92 (3.20)	17.92 (3.37)	17.93 (3.0)
Number of Sexual Partners**	0.37 (0.76)	0.44 (0.84)	0.28 (0.65)
Total Original HKSS**	68.39 (10.09)	67.56 (10.26)	69.42 (9.81)
Total Revised HKSS	44.04 (7.21)	43.69 (7.57)	44.42 (6.77)
Personal Capital*	9.32 (2.66)	9.14 (2.70)	9.52 (2.59)
Environmental Stability	11.66 (2.07)	11.63 (2.17)	11.70 (1.95)
Environmental Security	11.39 (2.39)	11.29 (2.38)	11.49 (2.39)
Social Capital*	14.24 (3.32)	13.67 (3.37)	14.53 (3.24)

* Sex difference significant at p=<.05, ** Sex difference significant at p=<.01, Ω categorical variable

Table 6: Correlations between HKSS scale scores and life history variables by sex

Variable	Age of Puberty		Age of First Sex		Number of Sexual Partners	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Personal Capital	.01	.15**	-.25**	-.01	.23**	.04
Environmental Stability	.02	.11*	-.16**	.09	.11**	-.03
Environmental Security	-.03	.12**	.11**	.05	.03	-.08
Social Capital	-.09	.03	-.17**	-.01	.14**	-.07
Revised HKSS Total	-.04	.13**	-.29**	.04	.18**	-.05
Original HKSS Total	-.02	.13**	-.21**	.06	.16**	-.07

* significant at p=<.05, ** significant at p=<.01

Table 7: Social class correlations (N=782 - partial correlations in parenthesis)

	Age of Puberty		Age of First Sex		Number of Sexual Partners	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**
Environmental Stability	.02 (.03)	.12 (.14)	-0.15 (-.18)	.08 (.07)	.12 (.12)	-.03 (-.03)
Environmental Security	-.03 (-.02)	.12 (.14)	-.10 (-.12)	.04 (.04)	.03 (.04)	-.08 (-.08)
Personal Capital	.02 (.02)	.16 (.15)	-.24 (-.25)	-.02 (-.02)	.23 (.23)	.05 (.05)
Social Capital	-.09 (-.09)	.04 (.04)	-.18 (-.18)	.01 (.01)	.14 (.14)	-.07 (-.07)

The revised multidimensional solution built from the PAF analysis provided four identifiable factors that shared features with (but were not identical to) Giosan's original proposal. *Social Capital* items referred to access to kin, peer and social support networks, whilst *Personal Capital* encompassed measures of attractiveness. The remaining two factors focused on the environment. *Environmental Stability* represents items pertaining to quality, indicative of resource access. *Environmental Security* contains items linked to neighbourhood safety and cohesion. These factors depart from Giosan's idea of 'risk consideration' but contain items relevant to environmental threat. These four factors were correlated and represented the most parsimonious fit to the data. Whilst the revised solution does allow some evolutionarily driven interpretations to be made (discussed shortly), it must be stressed that we do not claim that this represents an underlying fitness continuum.

Previous research suggests that the switching point from growth to reproduction is a key indicator of future strategy-related behaviour. Belsky et al. (1991) postulated that environments that induce stress on parenting should foster earlier reproductive maturity and behaviour in offspring (e.g. earlier sexual onset and proclivity for multiple partners). Such individuals would be expected to have developed a strategy that is less K orientated. The HKSS is a measure of *current* conditions and fitness. As such, we should expect that those who retrospectively report a later age of puberty would currently report a higher score on measures that purport to assess K selection (presumably because this earlier biological event acts as a signal to adopt K-strategy related behaviour). This was not the case however. When sex-specific correlations are examined, a positive relationship exists for women (but not men) between the revised HKSS and pubertal onset, specifically in relation to the *Personal Capital* and both *Environment* subscales. Females living in safe, stable ecological conditions and who have high mate value are therefore more likely to delay sexual maturity. This is consistent with evolutionary and developmental literature (Belsky et al., 1991; Chisholm, 1999; Ellis, 2004). Furthermore, it may be that pubertal

onset is less critical for strategy development for males than for females. Research suggests that whilst female reproductive strategy is sensitive to ecological and familial environments, male strategies are often more dependent on peer networks (Del Giudice, Ellis & Shirtcliff, 2011; James, Ellis, Schlomer & Garber, 2012). It must be stressed however that the retrospective nature of this scale and the remaining measures makes it impossible to establish causal links and so such conclusions must remain speculative.

Contrary to Differential-K predictions, the revised HKSS total had a significant, positive relationship with the *Number of Sexual Partners* and a negative relationship with *Age of First Sex*. However, when sex-specific correlations were examined, these relationships held for men only, in relation to both the total score and the subscales. To the extent that these scales are measuring attractiveness and upward mobility, it is unsurprising that these correlations emerged. Research has consistently concluded that measures indicative of high status are positively correlated with female mate preferences (Borgerhoff-Mulder, 1990, 1992; Buss & Schmitt, 1993; Draper, 1989; Kanazawa, 2003; Perusse, 1993). It would be advantageous for high status males not only to reproduce with more partners, but to lengthen the window in which they have the capacity to do so. These results are therefore consistent with current evolutionary thinking, although contrary to predictions from Differential-K theory.

Several other findings are in line with expectations from life history theory. *Age of Puberty* was significantly, positively related to *Age of First Sex* and negatively related to the *Number of Sexual Partners*. Those who have invested more in growth therefore appear to postpone reproduction and have fewer sexual partners. Furthermore the significantly negative relationship between *Age of First Sex* and *Number of Sexual Partners* suggests that those postponing reproductive behaviour have fewer sexual partners across the lifespan. Relationships between key life history variables are therefore broadly consistent with the current theoretical and empirical literature (Belsky et al., 1991; Chisholm, 1999; Ellis et al., 2009; Negriff, Susman & Trickett, 2011). The sex differences which emerged in the life history variables also support previous findings (Carroll, Volk, & Hyde, 1985; Tanner, 1990). Males had a significantly greater number of partners whilst females reached reproductive maturity significantly earlier. The results of this study therefore corroborate previous findings regarding relationships between reproductive onset and reproductive behaviour but do not provide strong evidence to suggest that these relationships are part of a general "K-dimension" as predicted by Differential-K theory.

Issues with Psychometric Life History Theory Research

The need to make clear distinctions in what is being measured in life history research is crucial. In its original incarnation and in current evolutionary behavioural sciences, life history theory focused on a suite of objective biological life events (growth rate, offspring number, life expectancy) that were strongly correlated, giving rise to a slow (K) to fast (r) continuum across species (Pianka, 1970; Rushton, 1985). In evolutionary psychology, recent psychometric measures purport to measure individual differences in 'slow' or 'K' human life strategies, by assessing personality and attitudes (such as impulsivity, altruism, attitudes to relationships, Machiavellianism and planning), as well as current community and environmental variables such as religiosity and social cohesion. While personality and lifestyle may be *associated* with fast or slow life history strategies,

they cannot stand as proxies for them. It is important for research to establish the relationship between early objective life events (e.g. stress) and later life history outcomes (e.g. reproductive timing, mating strategies). Personality and lifestyle may represent (1) correlates of life history strategies or (2) mediators of the relationship between early life events and subsequent life trajectories. These alternatives can best be examined through longitudinal studies (see Belsky, Schlomer & Ellis, 2012; Simpson, Griskevicius & Kuo, 2012 for recent examples as to how this may be achieved). Our point is that we should not confuse psychological or sociological variables associated with a K or slow life history strategy with the behavioural strategy itself. This point can be highlighted particularly in relation to the HKSS.

What is the HKSS measuring? Given its inconsistent relationships with key life history variables, it is difficult to conclude that it accurately captures an adaptive "K strategy". Early validation studies (e.g. Giosan, 2006) correlated the HKSS scores with other self-reported lifestyle measures of education, health and social support. Because the HKSS scale assesses these variables, it is not surprising that significant correlations were found: HKSS (a self-report instrument) simply validated other self-reported data. Criterion contamination (Messick, 1989) may therefore be an issue in the HKSS, raising serious questions regarding its construct validity. This same criticism can be extended to other psychometric works of life history strategy (see Olderbak, et al., 2014 for an example). Are these lifestyle variables correlates of a K-adapted strategy? Since none of the items address objective life history events, it is hard to know. Life history strategies represent an individual's developmental response to the environment in which they inhabit. It is not clear whether (and how) items such as 'The neighbourhood where I live is safe' and 'I live in a comfortable and secure home' relate to objective measures of life history strategy as either correlates or mediators. Items such as "I live in an environment where I can easily go outside and enjoy nature" are also difficult to reconcile with life history strategy. Not only can this be interpreted in many different ways by the respondent, it is also difficult to see precisely how and why this affects adaptive behavioural responses. Such items measure the present environment, not how the individual's strategic trajectory was affected by the developmental environment. It is therefore important to recognise the distinction between environmental factors and individual personality and behavioural traits that are potentially affected by environmental factors. Current psychometric measures do not effectively demonstrate this distinction and how (and by what mechanism) the environment translates into fitness related behaviours is unclear.

We found significant social class differences on some sub-scales, with those in upper bands scoring higher on the HKSS than those in low-paying jobs or unemployment. It appears that the HKSS may to some extent be measuring the respondents' current "middle class lifestyle", with high scorers reporting greater comfort and security. However, it would be fallacious to assume that a "middle-class lifestyle" represents optimal fitness. Should we take quality of life as an indicator of life history strategy ('fitness'), rather than a measure of achieved (or inherited) economic wellbeing which may or may not be correlated with the adoption of a K life history strategy? This may be especially true in respect of items purporting to measure local environmental conditions in the original HKSS. It should be noted however that significant and non-significant relationships remain unchanged when social class is controlled. However we recommend that class is scrutinised

in future research using psychometric indicators of strategy and that the implicit assumption that class is independent of these measures should be treated with caution.

Very little research with psychometric indicators of Differential-K disaggregates data by sex to examine potential differences in trajectories and outcomes. This study identifies marked sex differences in the relationships between variables that are masked when sex is not considered. Muncer (2013) highlights that, in relation to the general factor of personality proposed by Rushton (based on the rationale of the K dimension), the competing needs of the sexes mean that personality traits that enhance success for males do not necessarily enhance success in females (Campbell, 1999; Daly & Wilson, 1983) due to differences in parental investment strategies (Trivers, 1972). The same argument applies to psychometric measures of strategy. In relation to the multitude of factors that are incorporated into measures such as the HKSS, the ALHB and the Mini-K, can a single aggregate "K-dimension" encompassing personality, health, behaviour and environment be sex-neutral? Our analysis tentatively suggests not, and that future work with such scales should consider sex differences when examining relationships with life history traits.

Although this paper focuses on fitness-related life history events as key criteria for validation, it should be noted that modern human behavioural ecology studies do not assume modern humans to be 'fitness maximisers'. Research clearly concludes that the adoption of fast and slow strategies in certain imposed modern conditions do not necessarily confer the anticipated fitness consequences that would be expected in ancestral environments (Clark, 2007; Clark & Cummins, 2009; Goodman, Koupil & Lawson, 2012). The modern mismatch between biological fitness and socioeconomic circumstances is well documented. However, consistent with research in behavioural ecology, key shifts in life history that can be objectively measured are still expected to be contingent on ecological conditions to some degree, and should show correlations with personality and lifestyle measures indicative of high or low K strategies (if these hypothesised relationships are accurate). If K-related psychological and lifestyle traits bear no relationship to key life history events and indices of fitness, it raises questions about the relevance of such constructs in general. We recommend that the best way to examine life history strategy is to employ well-designed, longitudinal studies with clearly defined measures, controls for confounding variables and consideration of the developmental environment, in a manner consistent with studies in human behavioural ecology (Nettle, Gibson, Lawson & Sear, 2013). If psychometric studies of life history are not validated against known indicators of fitness, we cannot conclude that emergent K-strategy clusters indeed represent functional psychological adaptations.

Study limitations and conclusion

There are methodological limitations in the present study. Firstly, despite attempts to gather as wide a sample as possible, the individuals studied were predominantly literate and middle class. Whilst this is a much broader sample than has been used previously with the HKSS and similar measures, a more comprehensive range of social class would be desirable. Broadening the age range to incorporate developing individuals would also be of interest in future studies. In our sample, the first 10 years of reproductive lifespan is (ages 15-25) is omitted.

Perhaps the largest methodological issue is the use of retrospective assessments of pubertal onset, as these can be unreliable (particularly in males where signs are often less memorable). This is a difficult obstacle to remedy and is precisely why longitudinal research is badly needed in this field to allow temporal ordering to be explored in greater detail. Questions regarding sexual behaviour and social class are sensitive (Tourangeau & Yan, 2007) and could be subject to social desirability biases. Although the study was conducted online and participants were assured of anonymity, no other controls were in place and this may have affected responses.

In summary, we conclude that the HKSS is best conceptualised as four related scales rather than a unidimensional or higher order fitness factor. These scales assess aspects of current lifestyle and our preliminary analysis does not suggest that they are related to life history milestones as predicted by Differential-K theory. We recommend that psychometric indicators of fitness that do not map to measurable fitness outcomes be treated with caution and that the field of human life history research can be better advanced through using longitudinal studies examining developmental environments and fitness or fitness-related outcomes.

2.2. Further issues with Differential-K Theory

The remainder of this chapter explores some of the additional issues surrounding the use of psychometric indices in examining life history strategies before outlining the approach adopted by this thesis.

2.2.1. Heritability of K and the mechanisms of selection

Differential-K research is guided by the assumption that the common 'K' factor is genetic and heritable (Figueredo, et al., 2006). Rushton (1985) proposed that all differences in personality and behaviour could be accounted for by heritable variation in life history strategy. (''An exciting if open-ended possibility is that one basic dimension — K — underlies much of the field of personality'' Rushton, 1985; p. 445). Based on data from monozygotic and dizygotic twins, Figueredo, Vasquez, Brumbach and Schneider (2004) estimated the heritability of a 'K' factor to be $h^2 = .65$. This estimate was taken as evidence to support Rushton's proposal that human life history strategies are not purely a result of socialization and environmental influences, but are established in the genotype.

Differential-K when applied to human individual differences predicts that clusters of behaviours and traits should appear together (Figueredo, Sefcek, Vasquez, Brumbach, King & Jacobs, 2005; Figueredo et al., 2006) and that natural and sexual selection foster these combinations to solve adaptive problems. Low-K clusters focus on mating rather than parenting, short-term rather than long-term gains and exploitative rather than cooperative behaviours. High-K characteristics represent the opposite of this pattern. The expression of high and low-K strategies would be dependent on a set of coordinated, regulatory genes that would result in a coordinated, adaptive strategy. Figueredo et al. (2005, 2006) propose that high and low-K strategies, representing alternative but adaptive phenotypes, are maintained in the population via negative frequency dependent selection. Both high and low-k strategies can co-exist as long as one is in a minority, with its net utility multiplied by the proportion of the population adopting the strategy equal to the corresponding value for the majority strategy. Negative frequency dependent selection has been proposed to underlie the heritability of mating behaviour (Gangestad & Simpson, 1990) and criminal behaviour (Rowe, 1996). Figueredo et al. (2005, 2006) however acknowledged that their psychometric work could show only indirect evidence of negative frequency dependent selection of K-factor traits. Figueredo et al. (2005) proposed that key genes would have specific effects on the development of prefrontal areas, the amygdala and the hippocampus which affect neuropsychological functioning (particularly in the domain of impulse control) that would be manifested in the behavioural expression of life history strategy.

Subsequent versions of Differential-K however began to create problems for this argument. As the structure of K became increasingly hierarchical (discussed in 2.1.2), the introduction of more traits as part of the life history dimension created combinations that are unlikely to be subject to the same selection mechanisms. Penke, Denissen and Miller (2007a,b), argued that negative frequency dependent selection could not encompass all the traits that the K-factor purported to explain. The number of genetic polymorphisms required to vary so many related traits would be too large to be maintained by this mode of selection, which is only viable if a small number of polymorphisms exist at a small number of genetic loci. Such a large number of polymorphisms being successfully passed to future generations to enable heritable strategies is highly improbable. As a small number

of polymorphisms that have such sweeping effects on phenotypic variation (and could thus alter the expression of so many individual traits) have never been identified, they argue against negative frequency dependent selection for the K-factor and recommend that life history researchers effectively distinguish between mutation-selection (for traits such as longevity and intelligence) and balancing selection (fluctuating selection pressures over space and time) for various independent personality traits.

As such, the actual selection mechanism(s) of the K and Super-K strategy are ambiguous. Over the past decade, this trait cluster has been proposed to be shaped by directional selection (Figueredo & Rushton, 2009), frequency dependent selection (Figueredo et al., 2005, 2006; Figueredo & Gladden, 2007) and more recently, environmental heterogeneity in which life history strategies are differentially adapted to social micro-niches (Figueredo & Jacobs, 2010; Figueredo, Wolf, Gladden, Olderbak, Andrzejczak, & Jacobs, 2010). How such a complex suite of traits underlying all of life history strategy can be heritable remains unresolved and little research supporting the above proposals has emerged. This shortcoming therefore limits the explanatory power of the K strategy. It should also be noted that recent revisions of Differential-K are more accommodating to the possibility of environmentally-induced plasticity in strategies, and suggest that strategy can be calibrated to some degree during key developmental phases (Figueredo, Cabeza de Baca & Woodley, 2013).

2.2.2. The K and Super-K hierarchy

As Paper One highlighted, work in the field of Differential-K has rarely focused on linking higher-order strategies to the actual fitness-enhancing behaviours deemed important by its earlier proponents (Rushton, 1985). Table 8 illustrates that while many studies have used recent psychometric measures of a K factor, only a small proportion have examined associations between the K-factor and fitness-enhancing behaviour. Many studies attempt to link traits together, creating a hierarchical structure of trait clusters (see Figure 4 for an example of the structure) representing an aggregate measure of strategy. This Super-K measure encapsulates all K-related traits, ranging from the specific to the general (analogous to models of cognitive abilities according to Olderbak, Gladden, Wolf & Figueredo, 2014) However, K and Super-K are rarely linked to life history fitness measures.

Measures such as the general factor of personality (GFP) are assumed to be subject to directional selection over evolutionary time, in much the same way as intelligence (Penke et al., 2007a). Intelligence, often referred to as ‘g’, is a domain-general mechanism that evolved to solve novel environmental problems (Chiappe & MacDonald, 2005). High g is unlikely ever to be disadvantageous, whilst low g puts individuals at risk of losing out to higher g competitors. This presumption is sometimes extended to GFP. According to Rushton, Bons and Hur (2008, p. 1182), high GFP individuals are ‘socially advantaged’. Rushton and Irwing (2011) suggested that people prefer high GFP individuals as partners and that their preferential selection as mates results in assortative mating creating a stable, recurring environment over successive generations with unidirectional selection for higher GFP. This assumes that ‘nice guys finish first’ where high GFP indicates ‘niceness’. However, studies of the Dark Triad personality (a blend of psychopathy, narcissism and Machiavellianism; Jonason, Li, Webster & Schmitt, 2009) suggest individuals who score highly on Dark Triad traits (corresponding to low GFP scores) have more sex partners and are more likely to pursue a short-term

sexual strategy (Adams, Luevano & Jonason, 2014; Carter, Campbell & Muncer, 2014; Jonason, Li, Webster & Schmitt, 2009).

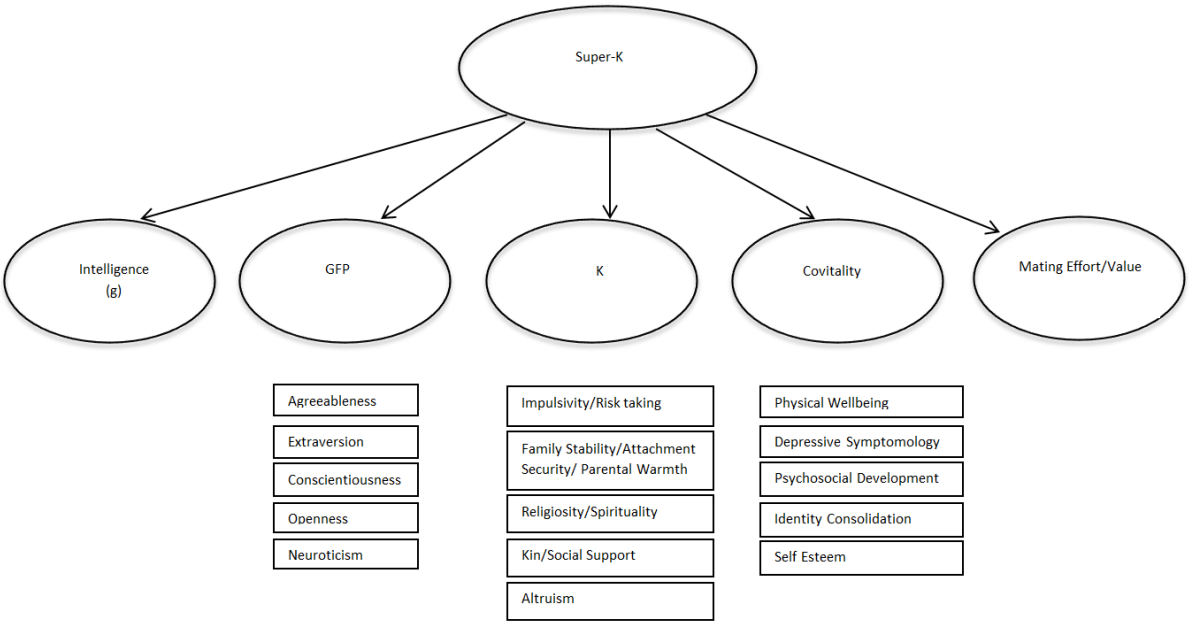

Figure 4: The Super K Hierarchy[2]

High GFP does not always confer reproductive advantage and (unlike *g*) low GFP does not necessarily entail disadvantage (Muncer, 2013) because different personality traits can be advantageous in different circumstances (see Nettle, 2006 for example). Indeed, extreme scores on GFP traits can incur fitness costs, for example, high agreeableness can foster high levels of dependency, pathologically so in some cases (Lowe, Edmundson & Widiger, 2009). GFP forms a key component of the K-strategy so that if GFP is under directional selection, as Rushton suggests, one would assume the same to be true of high -K strategy in general (as suggested by Figueredo & Rushton, 2009). This however (as mentioned in the preceding section) is not consistent with other works in the field of r/K strategy (see Figueredo, et al., 2005, 2006).

These conceptual differences in the constituent components of the K and higher-order Super-K factor pose problems for global psychometric indices, particularly where analysis involves parcelled measures (i.e. where components are aggregated into one observed variable, masking individual variation across the component traits). For example; One individual scores highly on Dark Triad measures and pursues short-term sex, has high *g* and a long life expectancy. Another individual who scores highly on conscientiousness and agreeableness, favours long-term pair bonds and has a lower *g* and life expectancy. These two individuals could have a very similar overall score on the K-Strategy battery, despite the fact that they vary markedly on subscale

[2] It should be noted that this represents an amalgamation of various representations of the super-k hierarchy. It is also not inclusive of all potential behaviours and traits. For other representations, see Dunkel, Mathes & Harbke, 2011; Figueredo et al., 2014; Gladden, Sisco & Figueredo, 2008; Olderbak & Figueredo, 2010, 2012.

scores and are in fact pursuing radically different strategies. Aggregating many related facets into a simple global score means that the ability to discriminate within the range of strategic possibilities is lost and raises questions about what this aggregate score is actually telling us. This may explain why many of the studies highlighted in Table 8 do not demonstrate significant relationships with life history behaviours.

Recent developments based on this K-approach (such as Strategic Differentiation-Integration Effort (SDIE; Figueredo, Woodley, Brown & Ross, 2013; Fernandes & Woodley, 2013; Figueredo, Cabeza de Baca & Woodley, 2013; Woodley, 2011; Woodley & Fernandes, 2014; Woodley, Fernandes & Madison, 2014; Woodley, Figueredo, Brown & Ross, 2013) suffer from problems similar to those highlighted here and in Paper One. The principle of SDIE is that groups of high K individuals will exhibit greater variation in strategy (hence lowering the magnitude of the correlations between items on measures of k). This is based on the hypothesis that competitive environments fostering K selection are more diverse than environments where mortality and unpredictability (examined further in Chapter Three; Ellis et al., 2009) are sufficiently high that parental investment cannot aid fitness and there is a population-wide strategy shift to early reproduction. In a highly competitive environment, it is argued, a single strategy may not be adaptive for all individuals and so K manifests itself differently to fit the competitive nature of the local ecology. As low K environments foster a focus solely on survival, diversity in strategy is not as adaptive. Whilst SDIE studies attempt to address some of the limitations of Differential-K, the choice of measures, the use of statistical parcelling, the continued reliance on predominantly student samples, and the use of correlational analyses make it difficult to examine causal processes and temporal sequences in life history research.

2.3. Evolutionary developmental psychology

The foundations of psychosocial acceleration theory (Belsky et al., 1991, Draper & Harpending, 1982) came mainly from principles of behavioural ecology (Belsky, et al, 1991), particularly the view that fitness-enhancing strategies are dependent on ecological conditions and that developmental plasticity is an evolved hominid function enabling response to environmental change. Whilst Belsky et al. acknowledge the role of genetic factors, the focus is firmly on how the environment shapes individual development through mechanisms of adaptive phenotypic plasticity (Penke, 2009; West Eberhard, 2003 – addressed in Chapter 3), as opposed to the heritability of traits or behaviour. For example, there has been lively debate over Belsky's key prediction that environmental stress predicts age of reproductive onset. In the Belsky et al. model, environmental stressors (such as father absence) foster parental insensitivity during the first seven years of an child's life, leading to insecure attachment and earlier reproductive onset (i.e. fast strategy) as part of a conditional strategy appropriate to the child's current and anticipated future circumstances (Belsky, 2000). This has been substantiated in the literature, with father absence and the introduction of non-related men (step fathers) accelerating pubertal development, particularly in girls (Ellis, 2004; Quinlan, 2003; Surbey, 1990; Webster, Graber, Gesselman, Croiser & Schember, 2014). By contrast, proponents of Differential-K, with their

Table 8: Summary of Psychometric Life History Studies

Study	Measure	Linked Traits	Fitness Related Linkages?	Sample	Method
Figueredo & Wolf (2009)	Mini K	Assortive Mating	No	South American Pub patrons	Correlation/Regression
Buunk, Pollet, Klavina, Figueredo & Dijkstra (2009)	Mink K	Height	No	Female Students	Regression
Figueredo, Andrzejczak, Jones, Smith-Castro & Montero (2011)	Mink K	Gender (sig), Mating Effort, Mate Value, Emotional Intelligence, Racism	Yes	Students	Factor Analysis/SEM
Salmon, Figueredo & Woodburn (2009).	ALHB	Eating Disorders, Female Competitiveness, Executive Function.	Yes	Female Students	Factor Analysis/SEM
Gladden, Figueredo & Snyder (2010)	ALHB	Self Esteem, Mate Value, Collective Self Esteem (Self Evaluation).	No	Students	Factor Analysis
Olderbak & Figueredo (2010)	Mini K	Mate Value, Personality, Relationship Satisfaction.	No	Romantic Couples	SEM/Correlation
Olderbak & Figueredo (2009)	Mini K	Relationship Satisfaction/Supportive communication	No	Students	SEM/Correlation
Gladden, Sisco & Figueredo (2008)	Mini K	Mate Value, Mate Effort, SOI, Psychopathy, Machiavellianism, Aggression	Yes	Students	SEM/Correlation/Factor Analysis
Gladden, Welch, Figueredo &	Mini K/HKSS	Religiosity, Spirituality, Moral	No	Students	Factor Analysis/SEM

Jacobs (2009)		Intuition, Disgust			
Gladden, Figueredo & Jacobs (2009)	ALHB	Psychopathy, Personality, Intelligence, Mating Effort, Risk Taking.	Yes	Students	Factor Analysis/Correlations
Giosan (2006)	HKSS	Interpersonal Support/Perceived Offspring Quality	No	Utility Workers	Correlation
Dunkel & Mathes (2011)	Mini K	Mate Value, Life Expectancy, Sexual Coercion, mating orientation	Yes	Students	Correlations
Dunkel & Beaver (2013)	Mini K	Life Expectancy, Self-Control, Criminal intent	Yes	Students	Correlations/Regression
Giosan & Wyka (2009)	HKSS	Mental Health, Anger, Sleep.	No	Disaster Workers	Correlations/Regression
Dunkel & Decker (2010)	Mini K/HKSS	Life Expectancy, SOI, Personality, Future Time Perspective	Yes	Students	Correlations
Dunkel, Mathes & Harbke (2011)	HKSS/Mini K	Personal Identity, Psychological Wellbeing, Self Esteem	No	Volunteers	SEM
Dunkel, Kim & Papini (2011)	HKSS/Mini K	Psychosocial Development, Personality	No	Students	SEM
Abed, Figueredo, Aldridge, Balson, Meyer & Palmer (2012)	HKSS/Mini K	Eating Disorders, Competition,	Yes	Students	SEM
Dunkel (2012)	HKSS/Mini K	Racial differences	No	Volunteers	Correlations
Figueredo, McDonald, Wenner & Howrigan (2007)	ALHB	Executive Function, Intelligence, Effortful Control	No	Students	Correlations
Wenner, Figueredo, Rushton	ALHB	Executive Function, Impulse	Yes	PALE volunteers	Correlations

& Jacobs (2007)		Control, Delinquency, Intelligence, Psychopathic Attitudes			
Dunkel, Mathes & Papini (2010)	Mini K	Life Expectancy, Aggression, Generativity	Yes	Students	Correlations
Giosan (2013)	HKSS	Depressive symptomatology, trauma, life experience	No	Utility Workers	Correlations/regression
Olderbank, Gladden, Wolf & Figueredo (2014)	HKSS/ALHB/Mink K	GFP, Mate value, Mate effort, intentions towards infidelity, self-monitoring.	Yes	Students	Correlations/SEM
Woodley, Figueredo, Brown & Ross, (2013)	ALHB/HKSS/Mini K	Intelligence measures	No	Students – two analyses using the National Longitudinal Survey of Youth	Continuous Parameter Estimation Model/Correlations.
Wenner, Bianchi, Figueredo, Rushton and Jacobs (2013)	Mini K	Executive function, risk, delinquency, drug abuse, life experience	No	One small community sample/larger student sample	SEM/Correlations
Tal, Hill, Figueredo, Frias-Armenta & Corral-Verdugo (2006)	ALHB	Water Conservation	No	Small Community Sample	FA/Regression
Olderbak & Figueredo (2012)	Mini K	Mating Effort/Intentions towards infidelity/GFP/Relationship Satisfaction/Self Monitoring/Supportive Communication	Yes	Students	Correlation/SEM

Woodley, Figueredo, Brown & Ross (2013)	Mini K/HKSS	Measures of g / CD-IE	No	Students (multiple samples)	FA/Continuous Parameter Estimation
Dillon, Adair, Wang & Johnson (2013)	Mini K	Mate Value (own and partners)	No	Students in a relationship/Facebook Opportunity sample	Correlation
Figueredo, Cuthbertson, Kauffman, Weil & Gladden (2012)	ALHB	Executive Function/Emotional Intelligence/SOI	Yes	Students	SEM

emphasis on genetic heritability, claim that absent fathers pass on genes that bias offspring towards faster strategies. They support this assertion by citing behavioural genetic findings that age of menarche and age of first reproduction show moderate heritability estimates (Kirk, Blomberg, Duffy, Heath, Owens & Martin, 2001; Rodgers et al., 2001; Rowe, 2000, 2002).

A key point emphasised by Chisholm (1993, 1999a) was that much of the initial work in early human life history theory was adaptationist in perspective, focussing on why selection should favour individual differences in reproductive strategy as opposed to precisely how these individual differences could arise. Adaptationist frameworks employ the 'phenotypic gambit' (Grafen, 1984): the assumption that theories about the function of reproductive behaviour do not necessarily require knowledge of the proximate mechanisms regulating that behaviour. Whilst adaptationism is still the predominant force in behavioural ecology, modern human behavioural ecologists are more open to the examination of mechanisms, particularly where behaviour departs from optimality (Nettle et al., 2013). Both Belsky et al. and Chisholm attempted to unite this ecological perspective with developmental psychology to provide a comprehensive framework, built upon life history assumptions that merges adaptationist and mechanistic perspectives. Life history theory assumes that individuals exhibit evolved reproductive strategies under varying conditions (adaptationist) but also that developmental plasticity in response to environmental cues shapes them (mechanistic). This approach therefore provides a research agenda in which to examine environmental stress, its effects on attachment patterns, its psychological manifestation in terms of personality, its effect on behavioural expression and its potential reproductive consequences.

Psychosocial acceleration theory from its earliest incarnations has now emerged as a perspective in its own right, with its principles forming the core of what is now often referred to as the evolutionary developmental approach ('evo-devo'). This approach contrasts with the evolutionary psychology approaches of Differential-K, by examining reproductive strategies from a broader developmental and environmental perspective. The use of more complex longitudinal models and, in some cases, the exploitation of natural experiments (Belsky, Schlomer & Ellis, 2012; James, Ellis, Schlomer & Garber, 2012; Pesonen, Raikkonen, Heinonen, Kajantie, Forsen & Eriksson, 2008; Nettle, 2010; Simpson, Griskevicius, Kuo, Sung & Collins, 2012; Tither & Ellis, 2008) means that this approach is more informative about how strategies develop and by what mechanisms. Whilst still predominantly correlational in nature, these studies do offer a window on key causal factors responsible for life history strategies. Proponents of 'evo-devo' do not necessarily focus on actual fitness outcomes per se, but also on the behaviours that would lead to fitness outcomes (much like modern human behavioural ecology) and, as emphasised in Paper One, do not stringently advocate a "counting babies" or "fitness maximisation" approach.

These models also have the advantage of more cogently incorporating some of the later developments that emerged in life history research, specifically the incorporation of the effects of mortality (Charnov & Berrigan, 1990; Chisholm, 1993; 1999a; Promislow & Harvey, 1990; Stearns, 1992) which have been shown to be as important to strategy development as density-dependent factors. Given that the traditional r/K dimension has been superseded by the greater explanatory power of age specific-mortality on life history strategy (Stearns, 1992), its continued use by many evolutionary psychologists is perplexing. Whilst Differential-K now includes

references to mortality, this is mainly through its incorporation into another super-factor (Covitality) which precludes examination of the causal role this important variable may play. This super factor also often appears as an individual difference rather than an ecological cue, further confounding the ability to examine causality. Longer life expectancy becomes a manifestation of life history strategy rather than a factor in its emergence. Evolutionary-developmental and human behavioural ecology approaches measure mortality using a variety of indices within their conceptual models (see Chisholm, Quinlivan, Peterson & Coall, 2005; Griskevicius, Delton, Robertson & Tybur, 2011; Hill, Jenkins & Farmer, 2008; Nettle, 2010; Quinlan, 2010) in order to show its effects on reproductive behaviour, as opposed to examining only its position within a hypothesised super factor.

Related to the Covitality and GFP factors used by psychometric researchers is the issue of psychological wellbeing. According to Belsky (Belsky, 2007; Belsky et al., 1991), the developmental system was designed to promote reproductive fitness by facultatively adjusting development to match the environment. This does not necessarily promote psychological wellbeing because this is not a prerequisite of enhanced fitness outcomes. In contrast, Covitality and GFP approaches measure wellbeing as an intrinsic part of a high K (or Super-K) strategy (Figueredo et al., 2004; 2007). Whilst it is reasonable to expect that securely attached infants are more likely to exhibit traits in later life that could be considered psychologically positive (i.e. absence of depression, high agreeableness, conscientiousness etc.), these traits are not a guarantee of reproductive fitness.

Psychosocial acceleration theory offers scope for the measurement of many different pathways in strategy development whilst the psychometric approach presents a more polarised view of life history strategies as high or low K (particularly so when K is presumed to be directionally selected for). Recent incarnations of Differential-K have begun to acknowledge the potential for multiple strategy expressions (such as SDIE). For example, a recent Q-sort paradigm (Sherman, Figueredo, & Funder, 2013) demonstrated that participants who are high or low in K can exhibit psychological traits contrary to the hypothesised Differential-K dimension. However this work is still comparatively recent and does not address all of the shortcomings highlighted in this chapter. Whilst the Differential-K approach shares much of its theoretical underpinnings of life history strategy, many of its limitations (particularly its lack of focus on causal and developmental pathways) make psychometric measures incompatible with testing the key predictions of psychosocial acceleration theory.

2.4. The current approach

This chapter aimed to evaluate psychometric measures of life history strategy and to compare Differential-K and evolutionary developmental models. Whilst acknowledging that Differential-K has been useful in highlighting behavioural and personality clusters associated with life histories, there are significant conceptual and methodological limitations associated with the use of their instruments in evaluating psychosocial acceleration theory as a causal, mechanistic process. The aim of this thesis is to investigate some of the basic questions raised by psychosocial acceleration theory: What stress cues do individuals respond to? What components of time preference act as psychological mediators or correlates of life history decision making? Do these vary between males and females? This thesis follows conceptually and methodologically in the tradition of Belsky et al., (1991) and later ‘evo-devo’ incarnations of life history strategy.

CHAPTER THREE

Conceptualising Environmental Stress

3.0. Introduction

This chapter focuses on defining familial stressors (Belsky et al., 1991) and environmental uncertainty (Chisholm, 1993, 1999a) which are the proposed ultimate causes of the aggressive and sexual behaviours this thesis will explore. Until recently, stress and uncertainty have been ill-defined. This chapter focuses on identifying specific cues to stress and uncertainty by examining data at the level of society and the individual.

As explored in the introduction, ecological stress is manifest in many different ways, but its impact on the developing child is via the parent(s). According to psychosocial acceleration theory, ecological conditions place strain on parental investment. Differing levels of stress result in a range of expressed parenting styles, such as father absence, single parenthood, and abusive parenting in response to high stress and monogamous pair bonding and bi-parental care where stress is low or absent. During the first five to seven years of life, the child uses information from its parents to internally represent a sense of its own future in the form of the internal working model (IWM). The role of the family unit is therefore perhaps one of the most important indicators of future life history strategy (as Papers Two and Three will demonstrate). Some of the issues surrounding the concept of stress in the context of life history theory will be briefly discussed before attempting to frame the aims of this chapter and presenting Papers Two and Three.

3.1. Plasticity

There are different interpretations of how developmental plasticity occurs including differential susceptibility (Belsky, 1997; 2005; Belsky & Pluess, 2009), sensitivity to context (Boyce & Ellis, 2005; Ellis, Essex & Boyce, 2005), adaptive calibration theory (Del Giudice, Ellis & Shirtcliff, 2011) and stochastic sampling (Frankenhuis & Panchanathan, 2011). Whilst these theories share many commonalities (and can be seen to an extent as a progression of ideas), there are differences between them. This thesis however, focuses on examining the cues in the environment that may promote developmental plasticity, rather than the mechanism itself (reviewed in Belsky & Pluess, 2013).

Proponents of psychosocial acceleration theory make the crucial claim that, whilst the genome of an individual is implicated in strategy expression (as discussed in the previous chapter), individual phenotypes are not fixed at birth and interactions with the developmental environment create scope for phenotypic plasticity. Gene-environment interactions foster the development of the individual in a complex and interactive fashion (Plotkin, 1994; West-Eberhard, 2003). In Chisholm's conceptualisation, the mechanisms proposed by Belsky et al. (1991) are designed to solve the 'uncertain futures' problem (Plotkin, 1994). A genetically fixed strategy would not be adaptive in a changing environment as there is likely to be a mismatch between the strategy and the later reproductive environment. Plasticity therefore allows organisms some flexibility to environmental changes during development, allowing them to make the best investment decisions for their limited resource pool (Plotkin, 1994; Slobodkin & Rapoport, 1974).

Whilst traditional developmental approaches (often termed the Developmental Psychopathology Model; Ellis et al., 2012) focus on stress disrupting or disturbing what should be a normal, secure, optimal attachment, evolutionary principles see stress as a guide or regulator that shapes the developmental process to adapt to changing circumstances (Belsky & Pluess, 2013). Psychological wellbeing is not the goal of reproductive strategies. The goal is reproductive fitness, regardless of the attachment security, psychological happiness, autonomy or sensitivity of the individual. Behaviours that can contribute to achieving this (such as aggression and promiscuous mating habits) are not therefore pathogenic or maladaptive, but rather alternative, successful phenotypes, plastically calibrated to the environment of the individual.

Adaptive developmental plasticity is the term adopted by many evolutionary theorists for this complex process (West-Eberhard, 2003). Evidence for human plasticity to environmental circumstance is substantial (see Belsky & Pluess, 2013 for a review). It should be noted also however that plasticity is not unconstrained (Chisholm, 1999a). There are substantial individual differences in plasticity (Belsky, 1997; 2005; Belsky & Pluess, 2009) as well as potential costs (Frankenhuis & Panchanathan, 2011), particularly as changes to the soma cannot easily be undone. For instance, adapting to environmental circumstances early in life may create a later mismatch with the environment at the time of reproduction, thus diminishing reproductive success (Nederhof & Schmidt, 2012). Recent challenges to psychosocial acceleration theory include issues with the nature of plasticity, specifically that if environmental autocorrelations are high enough that the environment is reliably predictable, plasticity would offer no advantage and development would be better served through a phenotype determined at birth (Baig, Belsare, Watve & Jog, 2011; Nettle, Frankenhuis & Rickard, 2013; Rickard, Frankenhuis & Nettle, 2014). Whilst mathematical models appear to show some support for this challenge, observational or experimental data regarding this matter (particularly in humans) is currently lacking. Recent re-evaluations by Del Giudice (2014) also dispute the strength of these claims.

3.2. Mortality

What features of the environment represent stress or, as Chisholm (1993;1999a) terms it, uncertainty? This is an important question for those who study patterns of adaptive behaviour but also for providing insight into factors that precipitate socially 'maladaptive' outcomes that could potentially be ameliorated. Belsky et al. (1991) focused mainly on stress in the family unit caused (in the original work) by largely unspecified sources. Chisholm (1993) developed this perspective further by claiming that any source of stress that reflected local mortality would affect family stress: "…ultimately, universal sources of parental stress are the routine social and environmental causes and correlates of high mortality rates --- poverty, exploitation, hunger, disease, and war and their accompanying fear and hopelessness" (Chisholm, 1993, p.7). This alignment of parental stress with local mortality was a major step in conceptualising strategy development.

Evidence suggests that age-specific mortality rates are a crucial factor in life history trajectories and they are one of the reasons why contemporary life history theory has moved away from traditional r/K models (Stearns, 1992). Crucially, Promislow and Harvey (1990, 1991) suggested that in mammalian species "[age-specific] mortality may be the unifying concept in explaining much of life history variation" (1991, p.126). Higher mortality fosters faster life history strategies. In humans, according to Chisholm (1993, 1999a), cues to

mortality would be transferred indirectly to developing children via the attachment mechanism (see Chapter One). The more a parent can invest in a developing child to buffer them from external sources of threat, the more secure the attachment bond. There is now a well-established corpus of research to substantiate the role of mortality. Mortality rates (usually measured via life expectancies) have been linked to aggression (Brezina, Tekin & Topalli, 2009; Dunkel, Mathes & Papini, 2010; DuRant et al., 1994; Wilson & Daly 1997); onset of menarche (Chisholm, Quinlivan, Peterson & Coall, 2005; Coall & Chisholm, 2003); early child birth (Burton, 1990; Chisholm et al., 2005; Geronimus, 1996; Griskevicius, Delton, Robertson & Tybur, 2011; Nettle, 2010, 2011; Quinlan, 2010; Wilson & Daly, 1997); low birth weights (Coall & Chisholm, 2003; Nettle, 2010); duration of breast feeding (Nettle, 2010) and the desire for more offspring (in males but not significantly in females; Matthews & Sear, 2008). Evidence of the impact of mortality on reproductive strategies is therefore compelling.

It should be emphasised that when mortality is studied in life history frameworks, the source of mortality is usually attributed to environmental factors, thus constituting forms of external mortality. Internal mortality is rarely studied in this field although some recent studies have given it consideration (see Matthews & Sear, 2008). Internal mortality is important as death through disease, infection, accumulation of deleterious mutations, and parasite load are all threats to survival. Recent theoretical discussions of the role somatic deterioration and the potential role of internal state predictions add an interesting dimension to the field of evolutionary developmental psychology (Nettle, Frankenhuis & Rickard, 2013; Rickard, Frankenhuis & Nettle, 2014). Whilst acknowledging the importance of such threats, this thesis focuses on external sources, following the tradition of most life history research.

A final interesting point regarding the effects of mortality is the fact that it demonstrates considerable sex differences, like many other component features of the psychosocial acceleration model. A review by Kruger and Nesse (2006), based upon the concepts of sexual selection and parental investment theory, demonstrated that males are much more likely to die from both internal and external sources of mortality across a variety of contexts (including the U.S. population, hunter gatherer societies, higher-order primates and across socioeconomic contexts).

3.2.1. Conceptualising the environment

Chisholm's (1993) earlier definition of the sources of stress (see 3.1) is very broad. In western societies particularly, the factors he described as inducing stress (e.g. hunger, disease, war) are not prevalent, yet variation in life history strategy persists. Such factors also offer little scope for implementing practical interventions. Whilst life history research (until relatively recently) has been somewhat vague about the specific factors affecting life history strategies, other disciplines (developmental and social psychology, sociology and criminology in particular) have intensively studied environmental correlates of aggression and reproductive behaviour. Whilst identifying these environmental correlates is informative, few studies have examined them simultaneously in relation to multiple behavioural outcomes. Because psychosocial acceleration theory predicts that stressors act cumulatively, a piecemeal approach cannot encompass the process holistically. Hypothetical associations have often been proposed but, until relatively recently, few models have tested multiple stressors

and/or multiple outcome behaviours (see Belsky, Schlomer & Ellis, 2012; Brumbach, Figueredo & Ellis, 2009; Hill, Jenkins & Farmer, 2008; James, Ellis, Schlomer and Garber, 2012; Simpson, Griskevicius, I-Chun Kuo, Sung & Collins, 2012). Papers Two and Three attempted to fill this gap. Factors that in past research have shown similar effects on both aggression and reproductive behaviour were selected in order to determine which (if any) had an impact on strategy development. The description and justification of these factors appears in Papers Two and Three.

3.2.2. Harshness and unpredictability

A comparatively recent theoretical analysis of the concept of environmental stress has received much attention. Ellis, Figueredo, Brumbach and Schlomer (2009) reviewed life history studies (both animal and human) in order to conceptualise how variation in strategy can emerge through the differential impact of two key dimensions: harshness and unpredictability. A third factor (general resource scarcity) was also postulated to play an important role. Differing combinations of these dimensions result in different resource investment patterns and bet-hedging strategies, with effects on phenotypic adjustment and life history strategies. These will be addressed in turn.

The initial factor to consider is resource scarcity or energetic stress. All organisms require a base level of energy to develop. Ceteris paribus, an energy surplus fosters faster development and reproduction as the ready availability of resources gives individuals a chance to flourish. If bioenergetic resources are low however, the emerging phenotype becomes "resource sparing" adopting a slower life history strategy, waiting for sufficient resources before beginning (or resuming) reproduction. Energy is conserved to maintain survival in the first instance. Only if surplus resources are available can the body sustain development towards reproductive onset. The interaction of harshness and unpredictability (discussed below) then interact with resource level to further inform strategy. Ellis (2004) reviewed evidence to suggest that poor nutrition delays puberty in girls. Studies on hunter-gatherers suggest that poor resource availability affects ovulatory cycles and general reproductive functioning, delaying reproductive onset (Ellison, 2001; Hurtado & Hill, 1990). This may also explain the Western secular trend of decreasing age of puberty as general nutritional circumstances have improved over the past two centuries (de Muinck Keizer-Schrama & Mul, 2001). In contemporary western civilization, resource thresholds sufficiently low to delay puberty are very rare and thus unlikely to explain much of the variation in life history strategy. Harshness and unpredictability are thus more relevant to the current thesis.

Harshness in an environment indexes local morbidity and mortality rates (morbidity is important as serious injury and disability can be as detrimental to fitness as death). The significant impact of mortality rates on reproductive strategies was discussed in section 3.2. However, Ellis et al. made additional predictions based upon the incorporation of age-specific mortality into life history theories. If juvenile mortality is high, parents should focus on protecting the young and ensuring they survive. This fosters slow strategies with relatively small numbers of offspring, with the aim of allowing at least one offspring member to survive to reproduce. When adult mortality is high, strategies focus on increasing the speed of reproduction, ensuring reproduction commences before potential mortality events. Ellis et al. review at length the effects of variation in harshness

with examples from animal research to support their hypothesis. Whilst their consideration of age-specific mortality is theoretically important in relation to strategy development, research shows that juvenile and adult mortality rates are highly correlated, and that juvenile rates often predict adult rates (Walker, Burger, Wagner & Von Rueden, 2006). Overall mortality rates (in human populations) may therefore be more pertinent to strategy differentiation. Most human models of life history however do not distinguish between juvenile and adult mortality rates and so more research is required to test some of these predictions. As such, most contemporary research (including the current thesis) does not make this distinction.

The remaining key dimension is unpredictability. Environments are rarely static and thus levels of mortality can vary over time. Unpredictability refers to the relative stochasticity of the environment. Ellis et al. draw upon contemporary bet-hedging theory to explain how fluctuating unpredictability changes investment behaviour. Greater unpredictability will foster faster strategies, as investing in an unknown future is inherently risky (Chisholm, 1999a; Gardner, 1993). Under high unpredictability, selection favours greater reproductive effort and less parental investment to promote more offspring with potentially greater genotypic/phenotypic diversity, in the hope that at least one offspring will survive (diversified bet hedging). Lower environmental variance increases predictability and allows for higher investment in offspring, preparing them for a future that can be reliably anticipated (conservative bet-hedging). This dimension is synonymous with Chisholm's (1993, 1999a) initial ideas where the ability to predict the future (addressing Plotkin's (1994) uncertain futures problem) is crucial to strategy development.

How do these dimensions of harshness and unpredictability interact? Once an organism has sufficient resources to maintain development, phenotypic variation results from variation amongst these two critical dimensions. Combinations of different values on these factors can induce radically different strategy types. For example, an environment that is high in harshness and high in unpredictability is likely to foster a fast strategy, as unpredictable mortality is high and unlikely to be ameliorated by continued parental and somatic investment in the offspring: Achieving reproductive viability early affords greater long-term fitness returns under such circumstances. However, higher harshness but lower unpredictability fosters increasingly slower strategies. Here, somatic investment may buffer against predictable sources of mortality and allow a small number of competitively successful offspring to survive. Combinations of these two factors therefore create variation in life history strategies.

Based on this conceptualisation of the environment, Ellis et al, (2009) made some specific predictions about important environmental cues pertaining to harshness and unpredictability. They suggested that low socioeconomic status, poor health, exposure to and involvement in conspecific violence, neighbourhood breakdown and low parental investment could all be considered indices of morbidity and mortality (harshness). Recent studies using this framework have implemented these variables as indicators of both harshness and unpredictability (Belsky, Schlomer & Ellis, 2012; Brumbach, Figueredo & Ellis, 2009; Simpson, Griskevicius, I-Chun Kuo, Sung & Collins, 2012), demonstrating that these two dimensions are both significant and appear to have independent effects on life history variables.

Ellis et al.'s conceptualisation has stimulated fruitful new lines of enquiry and produced important research findings in the past five years. Furthermore, the theoretical distinction between harshness and unpredictability has generated new predictions and testable hypotheses, as well as providing clarity as to why life history strategies may vary. However, there is still a need to specifically identify and measure (rather than only conceptualise and classify) environmental cues that influence life history strategy development, and little work has been conducted to incorporate other known stressors (such as density, sex ratio, and opportunity). From an interventionist standpoint also, knowing the cues that effect trajectories may allow interventions to ameliorate or mitigate them. An important issue with Ellis et al.'s proposal is that harshness and unpredictability are not always clearly distinguishable. Conspecific violence for example is harsh but it can also vary in its predictability. Being attacked regularly after school by a bully is predictably harsh, but being seriously attacked randomly over an extended period of time is unpredictably harsh. How can such a distinction be theoretically integrated and which is the bigger source of stress? Other factors such as income, familial interactions, educational opportunities and so on suffer the same problem (although attempts have been made to measure them; see Belsky et al., 2012; Simpson et al., 2012). This presents a measurement issue, as empirical models do not control for the fact that indices of harshness may also carry undertones of unpredictability. For example, few measures of conspecific violence (usually measures of delinquency, criminality or aggression) incorporate a stochastic element addressing its predictability. The two dimensions are therefore hard to independently operationalize for research purposes. However, regardless of whether environmental factors are classed as harsh and/or unpredictable, they still act as a stressor to the family unit and the developing child. Because stressors affect life history strategy, they are worthy of study independently of this theoretical demarcation. Thus, while this thesis will draw upon harshness and unpredictability for the purposes of discussion and interpretation, they are not used as dimensions of study in order to avoid confounding the two.

3.2.3. Levels of interpretation

A final issue for consideration is how environmental stressors are perceived and interpreted by the individual. According to Chisholm (1993, 1999a), the key mediating variable is the family unit. Uncertain conditions (harsh and/or unpredictable environments) foster higher levels of mortality risk, thus increasing the stress on parents. This increases instability in the family unit and thus the likelihood of unstable attachment bonds between parents and offspring. Thus, the family unit acts a mediator between the early environment and later behaviour in offspring. A wealth of research suggests strong links between family functioning and life history behaviours (see Paper Two for a brief review). The formation of the attachment bond in the first five to seven years of life drives future strategy development across the lifespan. Research indicates that attachment is reasonably stable from childhood to adulthood (Fraley, 2002; Waters, Weinfield & Hamilton, 2000) and thus the proposition that family processes in the early years affect offsprings' long-term reproductive outcomes and behaviours is feasible.

However, the extent to which family instability alone can account for variation in life history strategy is questionable. Recent work by Del Giudice (2009a), whilst acknowledging the relative stability of attachment across the lifespan, suggested that it can also alter over time, particularly between childhood and early adulthood (Bretherton & Munholland, 1999; Waters et al., 2000; Weinfield, 2000). Del Giudice also noted that strategies

may be recalibrated at various developmental stages (childhood, middle childhood, adolescence, early adulthood). If this is indeed the case, it raises the question of whether children are responding to stress only indirectly via the family. Whilst an argument can be made for this in infancy and toddlerhood (where the mother remains the secure base), children begin to experience and interact with the world directly from an early age. In modern Western society, schooling can start as young as age three, separating mother and infant for considerable periods of time. This separation increases with age and children interact with many different environments. Brofenbrenner's (1979) ecological systems model of development is a good example of how children are subject to influences from the community, school, family (including siblings and extended kin) and peers, many of which interact. It seems implausible to assume that children do not respond to the characteristics of the environment around them, including those that exert stress. Belsky et al. (1991) acknowledged the possibility that, throughout development, children can be susceptible to other family cues beyond the attachment bond (such as mother-partner arguments, partner changes, etc.). Several theorists have expanded this argument to include the child's direct perception of the wider ecological niche (Ellis et al, 2009; Geronimus, 1996; Wilson & Daly, 1997). The superordinate importance of the family as the mediating gateway to life history strategy is not firmly established and will be explored in Papers Two and Three.

A second issue relating to the impact of environmental stress is the unit of analysis. Many life history studies (and studies from other disciplines) identify environmental stress at the level of society. These studies are based on aggregate group-level data such as census returns, international indicators or other large population-based data sets (see Low, Hazel, Parker & Welch, 2008; Nettle, 2010; Wilson & Daly, 1997; Wilson & Pickett, 2009, for examples). Whilst these provide valuable contributions, it is difficult to reach conclusions about individual behaviour; the so-called "ecological fallacy" (Robinson, 1950). It should be noted that many of the findings of these macro-level studies have been replicated at the individual level. However there is some evidence to suggest that the individual's perception of environmental risk is more powerful in explaining behaviour than objective demographic indices. Johns (2010) in a sample of teenage mothers matched to mothers who gave birth in their late twenties, used neighbourhood and individual-level indicators of environmental quality to predict the likelihood of early pregnancy. Results indicated that individual perceptions of quality was a better predictor of teenage motherhood than neighbourhood level indicators. Belsky, et al. (1991) also emphasised the importance of the subjective experience of stress over objective measures. It is therefore vital to replicate macro-level findings at the individual level. When this is done, the tendency has been to focus on one or two variables, and usually, not simultaneously. This is a critical issue, as Ellis et al. point out (2009:254) "The fact that harshness and unpredictability, and their various moderating conditions, operate in an interrelated manner— meaning that just knowing one of these environmental dimensions does not afford accurate prediction of evolution or development—necessitates substantial consideration of each". Indeed, empirical evidence suggests that studies employing single predictors of early stress are less powerful than when multiple indices are modelled together (Nettle, Coall & Dickins, 2011). Thus, the environment should be measured as comprehensively as possible in order to achieve the most accurate picture of environmental stressors. A general theory of behaviour (which life history claims to be) that incorporates inter-related environmental factors should be applicable at all levels of analysis (Land, McCall & Cohen, 1990). Paper Three is a preliminary attempt to

match a macro-level model of environmental correlates to the same factors at the level of the individual's perception of them.

3.3. Aims of the current chapter

The two papers that compose this chapter examine the potential stressors that underpin the development of reproductive strategies. Paper Two[3] uses 2001 census data from England to examine strategy at a macro level. Census data have often been used to highlight key relationships in life history (Wilson & Daly, 1997, Nettle, 2010). However, as with much of the work in this field, the models rarely examine multiple dependent and independent variable simultaneously. Thus, Paper Two is an exploratory attempt to establish whether key demographic variables (or stressors) common in the current literature act in the way Chisholm (1993, 1999a) anticipated. Paper Three[4] is an attempt to validate the findings from Paper Two on a later census sample (2011). Furthermore, the model described in Paper Two is applied to a sample of individuals based on their perceptions and ratings of environmental cues. The studies move from macro to micro-level of analysis to build a comprehensive picture of environmental stressors in the context of life history theory. These studies will be evaluated at the end of the chapter.

[3] Copping, L.T., Campbell, A., and Muncer, S. (2013). Violence, teenage pregnancy and life history. *Human Nature*, 24, 137-157. doi:10.1007/s12110-013-9163-2

[4] Copping, L.T. & Campbell, A., (Under Review). The environment and life history strategies: Neighbourhood and individual-level models. *Evolution and Human Behavior*.

Violence, teenage pregnancy and life history: Ecological factors and their impact on strategy-driven behaviour.

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Abstract: Guided by principles of life history strategy development, this study tested the hypothesis that sexual precocity and violence are influenced by sensitivities to local environmental conditions. Two models of strategy development were compared: The first is based on indirect perception of ecological cues through family disruption and the second is based on both direct and indirect perception of ecological stressors. Results showed a moderate correlation between rates of violence and sexual precocity, r = .59. Whilst a model incorporating direct and indirect effects provided a better fit than one based on family mediation alone, significant improvements were made by linking some ecological factors directly to behaviour independently of strategy development. The models support the contention that violence and teenage pregnancy are part of an ecologically determined pattern of strategy development and suggest that, whilst the family unit is critical in affecting behaviour, individuals' direct experiences of the environment are also important.

Keywords: Life History, Violence, Teenage Pregnancy, Evolution, Environmental Uncertainty

Introduction

Violent crime and teenage pregnancy represent not only challenges to society, but to those who attempt to explain their aetiology. This study examines whether these social phenomena share common origins in the social structure of a person's environment, based on the idea that both may represent adaptive behavioural alternatives rather than symptoms of pathology.

There is a significant correlation between aggression and early reproduction: aggressive individuals tend to be more sexually precocious and active (Xie, Cairns, & Cairns, 2001). In females, early maturation is associated with earlier sexual behaviour and heightened aggression (Celio, Karnik, & Steiner, 2006). Girls with conduct disorder are also at greater risk from teenage pregnancies (Woodward & Fergusson, 1999). In males, mating effort (preference for short-term sexual relationships over long-term relationships) is related to antisocial behaviour (Lalumiere & Quinsey, 1996; Rowe, Vasonyi, & Figueredo, 1997) and serious delinquents are more likely to have sex early, impregnate partners and father children by age nineteen than those with less serious delinquency records (Wei, Loeber, & Stauthamer-Loeber, 2002). Teenage fathers are more likely to engage in criminal behaviour (Elster, Lamb, Peters, Kahn, & Tavare, 1987). Homicides and adolescent birth rates are

strongly correlated internationally, r = .95, and within the USA, r = .74 (Pickett, Mookherjee, & Wilkinson, 2005).

Environmental correlates of early pregnancy and violence have been investigated for many years. Established relationships between these phenomena suggest common etiological origins. However, studies rarely look simultaneously at aggression and early reproduction as dependent variables within the same investigation, leaving potential common etiological origins unexamined. A summary of frequently investigated social and environmental correlates of aggression and early reproduction that could represent such commonalities follows.

Economic deprivation is the most commonly researched correlate of aggressive and early reproductive behaviour. Aggression, child maltreatment, violent crime and juvenile delinquency are all significantly predicted by impoverishment measured as a composite variable from unemployment rate, poverty rate, and vacant housing (Coulton, Corbin, Su, & Chow, 1995). Intimate partner violence (Cunradi, Caetano, Clark, & Schafer, 2000) and lethal violence (Huff-Corzine, Corzine, & Moore, 1991) are both related to poverty, defined by low annual household income. Income inequalities across cultures are also related to increased levels of violence and teenage pregnancies; societies with wider income gaps demonstrate higher violence and higher teenage conception rates (Wilkinson & Pickett, 2009). Early sexual activity and pregnancy are significantly correlated with the number of girls classed as impoverished in urban localities (Brewster, 1994; Lanctot & Smith, 2001). Teenage fathers are significantly more likely than older fathers to have lower incomes (Tan & Quinlivan, 2006).

Measures of *family breakdown* are frequently correlated with aggression and early reproduction. Demographic studies note the strong correlation between divorce rates and aggression (Blau & Blau, 1982; Land, McCall, & Cohen, 1990). The likelihood of homicide victimization increases with the percentage of female-headed households within a locality (Dobrin, Lee, & Price, 2005). Coulton et al.'s (1995) analysis demonstrated that the number of female-headed households strongly correlates with neighbourhood violence rates. Associations between family breakdown (operationalized as parental separation, parental abuse, father absence etc.) and early sexual/reproductive onset have also been documented (Belsky, 2007; Chisholm, 1999a; Ellis, 2004; Ellis, Bates, Dodge, Fergusson, Horwood, Pettit & Woodward 2003; Ellis & Essex, 2007).

Allied to poverty, *lack of education* elevates rates of aggression and early reproduction. Violence levels are lower in areas with more high-school graduates (Dobrin et al., 2005). Schools with lower academic performance and lower staff-pupil ratios have higher pupil crime rates (Limbos & Casteel, 2008). Better education and academic achievement also appear to be protective factors against early sexual activity (Hallett et al., 2007; Laflin, Wang & Barry, 2008; Quinlivan, Tan, Steele & Black, 2004).

Neighbourhood *age and population structures* have implications for aggressive behaviour because criminal involvement peaks between the ages of 16 and 30 (Steffensmeier, Allan, Harer, & Streifel, 1989). The number of people aged 15 to 29 in large metropolitan areas is predictive of homicide rates (Land, McCall & Cohen, 1990). The age-crime curve is usually attributed to the fact that younger people have fewer resources despite being at their physical reproductive peak (Moffitt, 1993). Individuals therefore resort to risky strategies (including crime) to accrue more resources. This is especially true for males, a phenomenon that Daly and

Wilson (1985) refer to as "The Young Male Syndrome". Higher concentrations of youths competing for resources raise encounter rates between them, and consequent violence. Relationships between age structure and reproduction are less clear. Research suggests that population density has no effect on teenage pregnancy and live birth rates (Barbieri, 2004; Gawryszewski & Costa, 2005), although the opposite is true for aggression (Land et al., 1990). If the logic of the age-crime effect were applied to sexual activity, higher concentrations of youths would be expected to increase early reproduction rates. Males and females between the ages of 16 and 30 are in their reproductive prime and thus, increased encounter rates between them would be expected to increase the frequency of copulations and early pregnancies.

Sex ratios are the ratio of males to females within a locality: high ratios denoting an excess of males. South and Messner (1987) showed that an excess of women increases female crime rates. Barber (2000a) demonstrated cross-culturally that low sex ratios predicted higher homicide levels. Messner and Sampson (1991) reached similar conclusions examining 153 American cities. Similar effects of sex ratio have been demonstrated for early reproduction; low sex ratios being associated with higher rates of teenage pregnancy (Barber, 2000b). Guttentag and Secord (1983) proposed that, in societies with excess women, women's consequent loss of marriage market control would be characterised by broken homes, female-headed households, unsupervised children and increased violence. Children growing up in households characterised thus would develop similar reproductive strategies themselves.

Few theories explain how and why these ecological factors are relevant to both behaviours. Contemporary evolutionary science offers a framework in which relationships between aggression, sexual precocity and environmental factors can be reconciled: Life History Theory (LHT). LHT suggests that resources necessary for survival and reproduction available to organisms are finite. Consequently, tradeoffs are made between potential investments (see Kaplan and Gangestad (2005) for a review of LHT). One trade-off is between current and future reproduction (Schaffer, 1983); the choice between earlier reproduction at the cost of lower investment and possible deleterious health problems in offspring (e.g. low birth weight; Coall & Chisholm, 2003) or delaying reproduction until conditions are sufficient to enable higher parental investment at the cost of losing a proportion of reproductive lifespan. Trade-offs also emerge between reproductive quality and quantity. More children mean that resources have to be stretched, with lower investment in each, and poorer quality offspring that may be disadvantaged for future reproduction. Alternatively, having one child and investing heavily in it entails risk; if it dies, potential future descendants die with it. Should it survive however, it has a greater reproductive advantage when it reaches maturity. Trade-offs determine an organism's Life History Strategy; clusters of behaviours that guide organisms towards achieving maximum reproductive fitness in the environments in which they develop. Many postulate the existence of a fast/slow continuum of behaviours geared to this end. Cross-species research consistently shows that earlier reproducing species are more aggression-prone than those who reproduce more slowly (Eisenberg, 1981), suggestive of a faster LH strategy.

A crucial aspect of LHT is the identification of the specific environmental cues that trigger strategy selection and the mechanism by which this is achieved. Studies in LHT imply that cues suggestive of shortened life expectancy (such as high morbidity/mortality) drive strategy selection toward the fast end of the continuum (Brumbach, Figueredo & Ellis, 2009; Chisholm, 1999; Ellis, Figueredo, Brumbach & Schlomer, 2009). Those

living under conditions of high mortality are more likely to die young and develop behavioural strategies to avoid lineage extinction. Women reproduce earlier and more often, reducing investment in offspring. Despite poorer offspring quality, their numbers increase the probability that one or more will survive to reproduce. As reproductive fitness in males is often dependent on resource holding potential, males can increase their resources and status through within-sex competition. Aggression demonstrates strength, bravery and survivorship, increasing their desirability as partners whilst depriving competition of status and resources. Individuals living in ecological conditions of high mortality are therefore more likely to demonstrate higher rates of violence, crime and sexually precocious behaviour. Research confirms such relationships. Violence by young, black adolescents was negatively related to the belief that they would live to age 25; the effect being stronger for men than for women (DuRant, Cadenhead, Pendergrast, Slavens, & Linder, 1997). Homicide and age of first birth were strongly related to life expectancy in Chicago's urban neighbourhoods (Wilson & Daly, 1997). Interviews of members of a black community in the United States showed that ninety-one percent of women did not expect to live beyond age sixty, and that the transition to early motherhood was part of an accelerated family timetable calibrated to their assessment of life expectancies (Burton, 1990).

A key question is what environmental cues convey to individuals the likelihood of a short life expectancy and by what evolved mechanisms are these cues perceived? Two models have been proposed. In one, short life expectancy is signalled indirectly through disrupted family functioning. In the other, it is inferred both directly and indirectly from cues about quality of life in the local environment. We consider these in turn.

Draper and Harpending (1982) were among the first to highlight the importance of family functioning and its effects on reproductive strategy, specifically, the effects of father absence. They argued that females growing up in father absent environments adopt reproductive behaviour profiles calibrated to an anticipated future of unstable pair bonds and inconsistent or absent paternal investment in childrearing. Belsky, Steinberg and Draper (1991) developed this proposal by clarifying the evolved mechanism that calibrated future reproductive strategy. They suggested that the family environment as a whole was crucial to the behavioural, social and emotional development of children. Environmental uncertainty and attendant stress disrupt familial functioning, damaging bonds between parents and children and disrupting the attachment process (Bowlby, 1969, 1973, 1980). An insecurely attached child adopts an internal working model (IWM) of relationship uncertainty via their experience of parent-parent and parent-child interactions. These cues convey that the future is uncertain and serve to accelerate pubertal onset and early sexual debut as part of adopting a reproductive strategy suited to an uncertain ecological context. Chisholm (1993, 1999b; Chisholm & Burbank, 2001) added to this model of development by proposing specific mechanisms. Firstly, he suggested that the IWM determines a child's time preference. Time preference is an economic term, synonymous with psychological constructs such as time horizon, delay of gratification and impulsivity. Individuals with shorter time preferences favour short-term consumption and reproduction rather than long-term investment, devaluing the future relative to the present and altering reproductive schedules accordingly. Secondly, Chisholm unites parental stress with mortality, suggesting that "ultimately, universal sources of parental stress are the routine social and environmental causes and correlates of high mortality rates --- poverty, exploitation, hunger, disease, and war and their accompanying fear and hopelessness" (Chisholm, 1993:7). The key component of this argument is that wider environmental

conditions are signalled to developing children through the stability or instability of the family unit and that this signal conveys expectations regarding their expected length of life. Chisholm, Quinlivan, Peterson and Cole (2005) supported this model in a cross-sectional study showing that in women, early stress (indexed by parental conflict and father absence) correlated significantly with age of menarche, age of first birth and expected lifespan. Schwartz, Friedman, Tucker, Tomlinson-Keasey, Wingard, & Criqui (1995) demonstrated that childhood stress, indexed by parental divorce before age twenty-one, was associated with a forty-four percent increase in early mortality risk. Other indices of family breakdown were associated with mortality risk at about half of this strength. Prospective studies have also reported positive relationships between indices of family breakdown (especially father absence), aggression, criminality, early menarche and sexual debut (Belsky, Schlomer & Ellis, 2011; Carrasco, Holgado, Rodriguez & del Barrio, 2009; Ellis & Essex, 2007; Gibson & Tibbetts, 2000; Moffitt, Caspi, Belsky, & Silva, 1992; Su, Simons & Simons, 2011).

Ellis et al. (2009) offer a potential alternative mechanism. Although acknowledging the fundamental proposals of Belsky et al., they argue that individuals have evolved sensitivities to environmental cues pertaining to morbidity-mortality risks and stochastic variations in ecological conditions that can exert influence beyond the family unit; the presence of such cues uniquely contributing to the development of LH strategies. Ellis et al. propose that unpredictable developmental environments create internal unpredictability schemas; mental models representing the chaotic, unpredictable nature of both other organisms and the environment (see also Ross & Hill, 2002). By adopting unpredictability schemas, individuals become present-oriented with an accompanying increase in risk taking behaviours. Unpredictability schemas may act as a "mediating mechanism through which exposures to stochastic conditions shift individuals toward faster LH strategies (Ellis et al 2009:249)". Daly and Wilson (1997) drew similar conclusions, claiming that the mind unconsciously generates statistical composites of local mortality rates based upon observations of local populations. Evolution may have equipped the psyche to perceive changes in local mortality rates and calibrate LH strategies. Environmental cues are registered by individuals through multiple pathways and are likely to be interrelated, to operate on multiple levels and have a hierarchical influence on strategy development. Accordingly, whilst still being receptive to environmental cues pertaining to morbidity and mortality, individuals will also remain sensitive to how the same cues affect parents and subsequent parental investment. Ellis et al. (2009:254) argue that "The fact that environmental harshness and unpredictability, and their various moderating conditions, operate in an interrelated manner— meaning that just knowing one of these environmental dimensions does not afford accurate prediction of evolution or development—necessitates substantial consideration of each". What cues convey information about expected morbidity and mortality? Ellis et al. (2009) suggest low socioeconomic status, poor physical health, involvement in or victimisation from conspecific violence, indicators of neighbourhood deterioration and poor quality parental investment. To summarise "shorter life expectancies/higher mortality rates as indicated by the conditions of people's lives that reliably forecast premature aging or death facultatively accelerate LH strategies" (Ellis et al., 2009:247). Support for this model was reported by Brumbach et al. (2009), demonstrating that indices such as exposure to violence, lack of parental care and familial contact with social services were linked to LH traits in adolescence and young adulthood and that strategies are coherently formed by the time individuals reach their twenties. A longitudinal study (Simpson, Griskevicius, I-Chun Kuo & Sung, in press) found that sexual and criminal behaviour at age twenty-three was predicted by the level of

unpredictability experienced by age five (indexed by changes to mothers residence, employment and partners). Belsky et al. (2011) demonstrated similar results; focusing on sexual behaviour at age fifteen as the dependent measure.

In the present study, data from the England and Wales Census (2001) was used to examine indices of neighbourhood quality and family structure in relation to violent crime and teenage pregnancy. Analysis was guided by the following research aims. Firstly, to confirm the relationship between violence and early reproduction. Secondly, to determine which environmental factors are predictive of violence and early reproduction. Thirdly, to explore if environmental factors have both direct and indirect effects on these outcomes, as suggested by Ellis et al. (2009), or are mediated predominantly by family disruption (Draper & Harpending, 1982; Belsky et al., 1991; Chisholm, 1999a).

Method

Sample

Data from three hundred and thirty-nine local authorities[5] were collected online from the England and Wales Census (2001). The data from these areas covered 46,371,315 people in total. Local authorities (responsible for administering health, education, public safety and other government services over a geographic area) were selected as the unit of analysis, with no exclusion based on population size, for two reasons. Firstly, it was the smallest level of analysis from which all necessary data could be extrapolated from government figures. Secondly, the study aimed to disaggregate the nation into the smallest possible units in order to represent local environments as sensitively as possible.

Measures

Theoretically relevant variables from the Census were selected. Variables were selected on the basis of reflecting aspects of uncertainty, including characteristics of the local population structure. Data points were converted into either percentages of the population, or rates per 1000 to allow comparison whilst controlling for population size. Variables assessed the following domains:

Number of Youths: The number of youths (both sexes) between the ages of fifteen to twenty-nine was summed and calculated as a rate per 1000 of the population to create a single measure.

Youth Sex Ratio: It has been suggested by some (Barber, 2001) that the sex ratio of males and females of reproductive age is the most significant form of population sex ratio related to aggressive and sexually precocious behaviour. This ratio was calculated as the number of males per 100 females of the population aged 15 to 29.

Father absence: The measure of family breakdown used in this study was the rate of Female Lone Parents (per 1000 female adults). This was deemed theoretically appropriate given the body of research on the

[5] 13 out of 352 authorities were not included due to differences in their administration.

effects of father absence (Belsky et al., 1991, Draper & Harpending, 1982)[6]. Given the nature of the census data, we were unable to assess psychological aspects of family functioning (e.g. attachment, conflict).

Education: Educational attainment measures were recorded from the Census, specifically, the percentage of pupils achieving at least level 5 in English, Mathematics and Science. The British government's National Curriculum expects pupils to reach a minimum of Level 5 academic performance by approximately the age of fourteen. Because multiple indices were coded in relation to the *Education* variable, Principle Components Analysis was used to determine if the three indicators loaded onto one latent factor. One factor explaining ninety-four percent of available variance emerged. Internal consistency (Cronbach's alpha) of this scale was high at .97. Factor loadings ranged between .90 and .96.

Unemployment: This was indexed by the rate of jobseekers per 1000 adults.

Life Expectancy: Indices of life expectancy were recorded in the form of male and female disability-free life expectancy from birth. These were summed and divided by two to give an approximate measure of overall disability-free life expectancy. Disability-free life expectancy assesses the estimated years of life individuals can expect to have in good health and without physical or mental disability. This was deemed more theoretically appropriate than simple life expectancy given that poor health reduces the amount of available lifespan available to invest in parenting or reproduction (Ellis et al., 2009; Nettle, 2010) and would thus impact upon LH traits.

Population Density: This was indexed by the number of people per hectare.

Two dependent variables were used in this study, both extracted from census data. *Teenage Conception Rate* was indexed by the number of teenage pregnancies in females between the ages of 15 and 17[7] (calculated as a rate per 1000 for the census year). *Victimful Criminality* was indexed by summing the number of crimes from the following police categories; violence against the person, wounding or life endangering acts, other wounding offences, harassment and penalty notices for disorder and common assault. These all represent acts that involve aggression towards another individual[8]. This summed figure was then converted into a rate per 1000 of the total adult population for the census year.

Results

Descriptive statistics for all variables are presented in Table 9 alongside the intercorrelations between the predictor and outcome variables. *Victimful Criminality* and *Teenage Conception Rates* correlate positively and significantly, $r = .59$ ($p < .01$), confirming the expected relationship. Moderate to strong correlations exist between all independent variables and the two dependent variables (the exception being *Youth Sex Ratio* which

[6] We note however that this measure may include households where the father visits, where the mother cohabits with a male partner and where children experience stable mother-only environments.

[7] Teenage conception rates cover ages 15 to 17. Data on pregnancies at earlier ages are confidential and not recorded by local authorities. The actual number of teenage pregnancies in each local authority is therefore likely to be higher than recorded here.

[8] Homicide data were not obtainable at local authority level and so the Victimful Criminality score does not include it. Future works should attempt to integrate these figures if they become accessible.

is significant only with *Teenage Conception Rate*). These correlations are all in the same direction, suggesting that violence and teenage pregnancies rise and fall together in response to changes in ecological indicators (the exception again being *Youth Sex Ratio*).

Ecological threats: Father absence as a mediator or direct perception?

According to Belsky et al. (1991) and Chisholm (1999), ecological factors impact upon father absence which in turn affects violence and early pregnancy. Ellis et al. (2009) however suggest that direct as well as indirect perception of these ecological conditions is also possible. Structural Equation Modelling (SEM) was used to evaluate both proposals. Two SEM models were constructed to determine which model gave a better fit to the data. A latent variable (labelled "*Strategy*") was used to represent the hypothesised relationship between the two dependent variables. The two models are illustrated diagrammatically in Figures 5 and 6. In Figure 1, links between the independent variables and the Strategy variable are both direct and indirect (through father absence) thus representing the Ellis et al. conceptualization. In Figure 6, the direct linkages are constrained to zero in order to examine only the mediating effect of father absence. Fit statistics are reported in Table 10.

The models were applied to the whole sample and then compared. Observed variables are represented by rectangles and latent variables by ellipses. It should be noted that, for modelling purposes, all predictor variables were assumed to be correlated although, for reasons of clarity, these paths are omitted in the diagrams. Residual symbols (measurement error) and pathways constrained to zero are also omitted to aid interpretation. Coefficients for pathways represent standardised regression weights. All models were generated using Maximum Likelihood Estimation. Models were evaluated using several fit indices. A Chi-square test examines the significance between the restricted covariance matrix and the unrestricted sample covariance matrix. Significant p values indicate significant differences between the matrix predicted by the model and the matrix present in the data and are indicative of a poor fit. The CFI (Comparative Fit Index) compares the similarity between the covariance matrix predicted by the model and the matrix observed in the data. The Root Mean Square Error of Approximation (RMSEA) takes into account overall model complexity. CFI values should be greater than .90 whilst RMSEA values should ideally be lower than .10 (Bentler & Bonett, 1980; Byrne, 2001; Loehlin, 2004; Steiger, 1989). Finally, r^2 values show how much of the variance in each outcome variable is predicted by the hypothesised models.

Table 9: Table of Correlations and Descriptive Statistics (N=339)

	Violence	Pregnancy	Life Expectancy	Education	Unemployment	Father Absence	Population Density	Number of Youths	Youth Sex ratio
Pregnancy	.59**								
Life Expectancy	-.50**	-.79**							
Education	-.56**	-.78**	.69**						
Unemployment	.52**	.68**	-.79**	-.62**					
Father Absence	.61**	.78**	-.79**	-.69**	.79**				
Population Density	.62**	.49**	-.33**	-.48**	.42**	.55**			
Number of Youths	.55**	.42**	-.29**	-.46**	.39**	.43**	.65**		
Youth Sex Ratio	.01	-.26**	.25**	.14**	-.22**	-.30**	.01	.23*	
Mean	24.44$^{\alpha}$	38.93$^{\alpha}$	63.64$^{\Omega}$	.00$^{\beta}$	16.26$^{\alpha}$	58.45$^{\alpha}$	11.04$^{\pi}$	175.12$^{\alpha}$	100.47^{o}
SD	13.15$^{\alpha}$	13.04$^{\alpha}$	3.21$^{\Omega}$	1.00$^{\beta}$	9.31$^{\alpha}$	17.97$^{\alpha}$	12.72$^{\pi}$	30.34$^{\alpha}$	4.92^{o}

**p<.01 level, *p<.05, $^{\alpha}$ rate per 1000, $^{\Omega}$ years, $^{\beta}$ standardised regression weight, $^{\pi}$ people per hectare, ^{o} males per 100 females

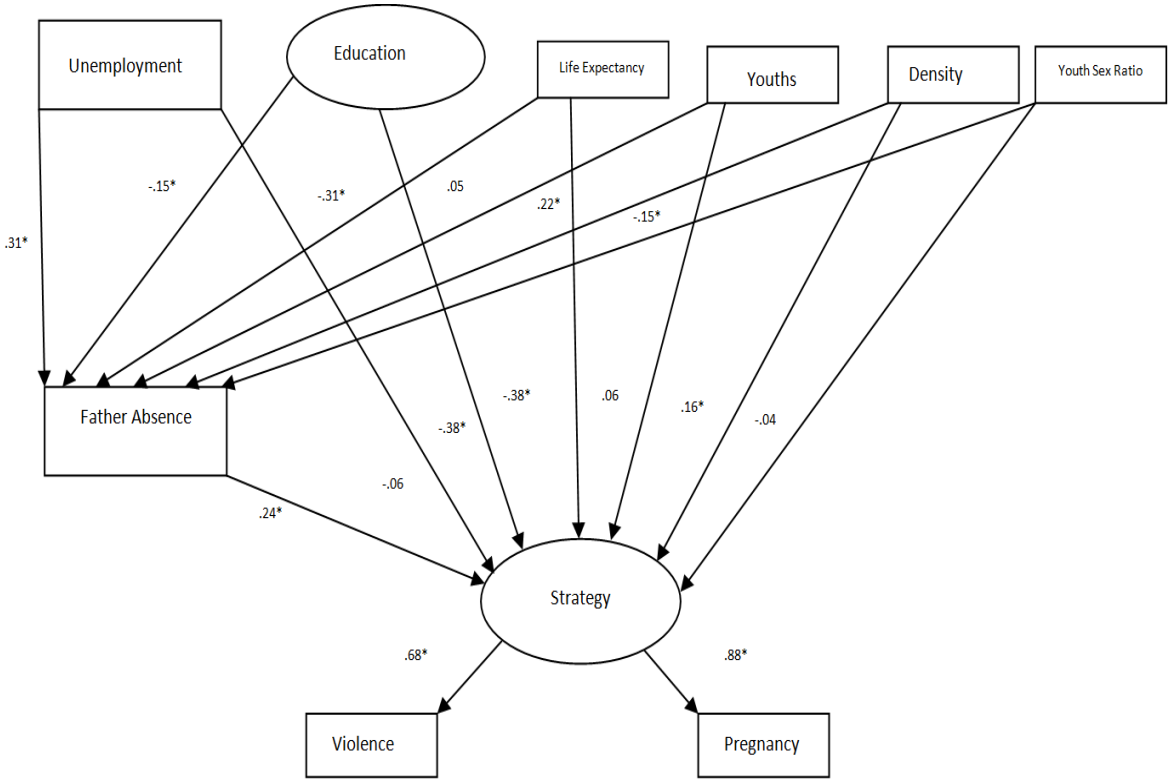

Figure 5: Direct and Indirect Model (*p < .001; Values represent standardized regression coefficients)

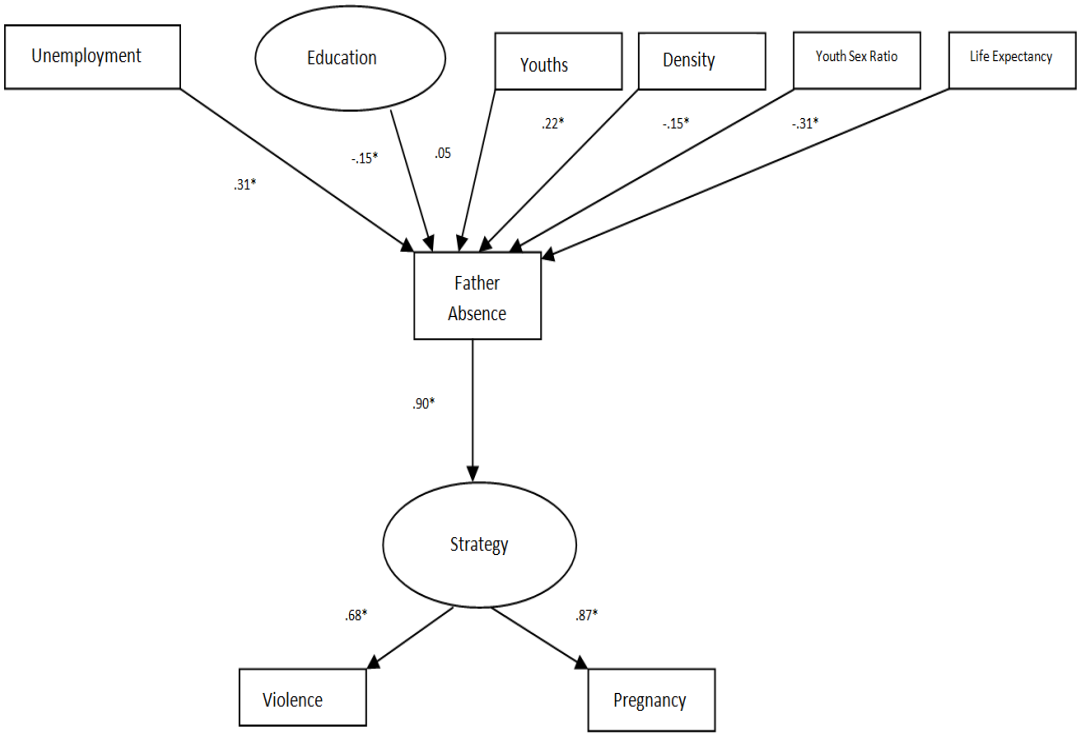

Figure 6: Family Mediation Model (*p<.001; Values represent standardized regression coefficients)

Table 10: Model Comparisons

Sample	n	VC r^2	TP r^2	X^2	DF	X^2/DF	P	RMSEA	CFI
Family Mediation Model	339	.47	.76	333.22	28	11.90	**	.18	.92
Direct/Indirect Model	339	.46	.77	144.34	22	6.56	**	.13	.97

Note, *p<.05, **p<.01, VC r2 (Victimful Criminality r2 value), TP r2 (Teenage Pregnancy r2 value)

The model based upon Direct and Indirect Perception predicts forty-six percent of the variance in *Victimful Criminality* and seventy-seven percent of the variance in *Teenage Conception Rates*. The Family Mediation model predicts forty-seven percent of the variance in *Victimful Criminality* and seventy-six percent of the variance in *Teenage Conception Rate*. Despite good r^2 values, fit statistics fail to meet the criteria of good models, with nearly all indicators failing to meet minimum thresholds. Fit statistics however show that the Direct and Indirect Perception model is significantly better than the Family Mediation model (X^2_{diff} = 188.88, df_{diff} = 6, p<.001). Nevertheless, both fall short of good fit to the data and the variance explained in the two dependent variables differs slightly between models. The models also differ in terms of significant predictor variables. In the Direct and Indirect Perception model, four variables significantly affect *Strategy*: *Father Absence, Education, Population Density* and *Life Expectancy,* whilst all links between *Father Absence* and the remaining variables are significant (with the exception of *Number of Youths*). In the Family Mediation model, all predictor variables significantly predict *Father Absence* which in turn significantly affects the *Strategy* variable (again with the exception of *Number of Youths*). All significant variables across both models act in directions predicted by previous research.

Modelling direct and indirect effects on strategy development

Both models, whilst conceptually plausible and showing patterns of relationships predicted in previous studies, fail to provide an adequate fit to the data. Despite this, many pathways between variables are significant and the r^2 values for both outcome variables are similar across models, suggesting that whilst the previous models are not compatible with the matrix present in the data, many pathways are important predictors of strategy-driven behaviours. An attempt was therefore made to re-specify the model based on Ellis et al. (as this presented a better fit) in order to establish a valid model.

The new structural model was created in the following manner. The sample was randomly split into two approximately equal subsamples. On the first subsample, an inclusive model with all direct and indirect effects was implemented; specifying all of the theoretical relationships between *Strategy*, *Father Absence* and the remaining predictor variables without constraints (consistent with the original Ellis et al. model). Furthermore, two additional modifications were made to this model. Previous research has found that *Population Density* and the *Number of Youths* are correlated with *Victimful Criminality,* but not with *Teenage Conception Rates* (Barbieri, 2004; Gawryszewski & Costa, 2005; see earlier discussion). The present data suggest the same pattern. It is therefore possible that these two variables affect *Victimful Criminality* independently of both *Strategy* and *Teenage Conception Rates.* In order to test this, two direct links were added

linking *Victimful Criminality* to *Population Density* and *Number of Youths.* Using the same sample, a restricted model was then created by removing all pathways that were not significant. Links were only removed if they fell below the p <.05 significance level. In this way, the exploratory model was guided by analysing the significance of relationships, rather than aiming to achieve a model with parsimonious fit statistics. The restricted model was then applied to the second subsample in an attempt to cross validate it and reduce potential Type I errors that may have emerged as part of the exploratory analysis. Finally, the model was applied to the whole sample for comparability with the original Direct and Indirect Perception, and Family Mediation models. In testing the models over multiple samples, it was hoped that a model could be created that was conceptually consistent with past research whilst being parsimonious with the covariance matrix of the data set.

Table 11 presents the fit statistics of the four models, whilst Figure 7 illustrates the standardised coefficients applied to the whole sample. Again, intercorrelations and residual error terms are omitted in the diagram. Table 11 shows that models omitting non-significant links between predictor and outcome variables, and adding the two additional links provide a more parsimonious fit to the data than the previous models. RMSEA and CFI values indicate patterns of results that are at least adequate in their fit to the data across all modified models. Although Chi-Square statistics are still significant, it should be noted that this indicator is sensitive to both sample size and strong inter-correlations between predictor variables (Kline 2005). Table 11 shows that the inclusive model is also an adequate fit to the data. However, many of the linkages were non-significant and the restricted model on the same sample produced a better fit, although not significantly so (X^2_{diff} =9.52, df_{diff} = 5, p>.05). Further testing of the inclusive model (by using the whole sample and the validation sample) also showed that the patterns of significant pathways and strengths of standardised beta weights differed across samples[9]. In the restricted model, across the two subsamples and the whole sample, the significance and the direction of the pathways illustrated in Figure 3 were more consistent (see appendix 1 for standardised regression weights of each model). The modified model is therefore more robust across samples and remains consistent with the existing body of research in LHT. Furthermore, the modified model is a significantly better fit to the data than the model based on Direct and Indirect Perception (X^2_{diff} = 56.89, df_{diff} = 3, p<.001) and on Family Mediation (X^2_{diff} = 245.77, df_{diff} = 3, p<.001).

Table 11: Modified Model Comparisons

Sample	**n**	**VC r^2**	**TP r^2**	***X^2***	**DF**	***X^2*/DF**	**P**	**RMSEA**	**CFI**
Inclusive Model	169	.54	.85	52.86	20	2.64	**	.10	.98
Restricted Model	169	.54	.84	62.38	25	2.50	**	.09	.98
Validated Model	170	.55	.85	45.83	25	1.83	*	.07	.99
Whole Sample	339	.54	.84	87.45	25	3.50	**	.09	.98

Note, *p<.05, **p<.01, VC r2 (Victimful Criminality r2 value), TP r2 (Teenage Pregnancy r2 value)

[9] All statistics available on request

Figure 7 illustrates the significant pathways present in this model. Similar to the original Family Mediation model, all predictors except the *Number of Youths* significantly predict rates of *Father Absence*. Of these, *Unemployment* and *Youth Sex Ratio* have no direct links to anything else in the model and only increase rates of *Father Absence*. *Life Expectancy* indirectly affects *Strategy* through its effect on *Father Absence* and this path is slightly weaker than its negative direct effect on *Strategy* (β = -.31 against β= -.34). *Education* shows a similar pattern of results (β = -.16 against β= -.44). The model suggests that family breakdown is more likely to occur in environments characterised by dense populations, high unemployment, low educational attainment, low partner availability for females (indexed by a significantly negative youth sex ratio) and poorer life expectancy.

Strategy itself is predicted by only three associated factors. Strategy development is directly sensitive to levels of *Father Absence*, local rates of Life *Expectancy* and poor *Education* opportunities. Any effects of *Unemployment, Youth Sex Ratio* and *Population Density* on *Strategy* are indirect through their impact on *Father Absence*, making them more distal predictors of strategy-driven behaviour.

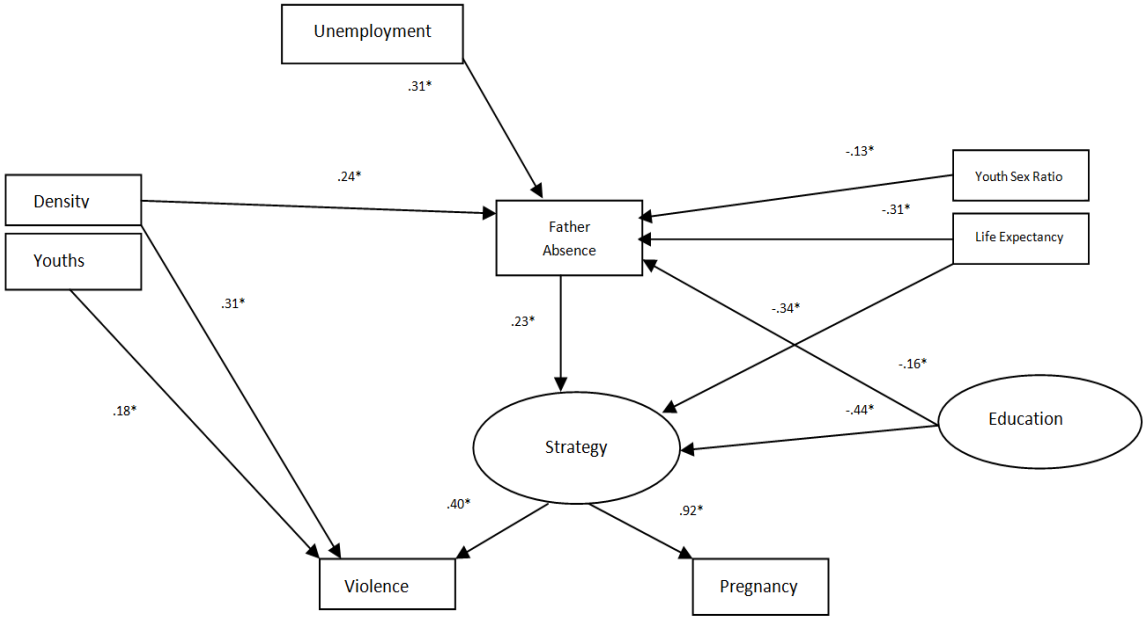

Figure 7: Modified Model (*p < .001; Values represent standardized regression coefficients)

Finally, the additional direct links between *Victimful Criminality* and *Number of Youths* and *Population Density* appear justified. *Number of Youths* is significant only for *Victimful Criminality* and not for *Teenage Conception Rate* (either directly or indirectly). *Population Density* shares the same positive link with *Victimful Criminality* whilst maintaining an indirect link via its effect on *Father Absence*. This suggests that local population structures can affect rates of violence independent of other factors. It should be noted however that *Population Density* does have a significant effect *on Father Absence* and thus may indirectly affect pregnancy rates through its effect on this variable.

Discussion

The results confirm that violence and sexual precocity are moderately related to each other, supporting the existing literature that aggression and sexual behaviour rise and fall together within localities. Moderate to strong correlations were also found between predictor variables in this study and both outcome behaviours. Environments characterized by low life expectancies, poor educational prospects, rising unemployment, high levels of lone parenting, low youth sex ratios and dense populations are conducive to increasing rates of violence and sexually precocious activity.

SEM was used to determine whether a combination of direct and indirect perception of ecological threats (Ellis et al., 2009) was a better explanation of strategy development than indirect perception through the mediating effects of family breakdown (Belsky et al., 1991; Chisholm, 1999). Conceptually, the Family Mediation model supports existing literature, in that almost all predictor variables are significantly related to *Father Absence* which in turn is positively related to the hypothesised strategy variable responsible for the expression of the behaviours of interest in this study. The poor fit statistics however suggest that this model in its present form is underspecified and more complex effects are likely to be occurring between these variables. Although Direct and Indirect Perception is a significantly more parsimonious model, it too is a poor fit to the data matrix. Some of the results were surprising. Three important variables highlighted in the literature (*Unemployment, Number of Youths and Youth Sex Ratio*) were non-significant in their relationship with the hypothesised strategy variable. This suggests that the relationships between the predictor variables are more complex than specified in this model and that the unique contributions of some predictors were masked by the effects of others.

The revised model more cogently highlights the importance of both direct and indirect perception in strategy development. Furthermore, despite achieving only an adequate statistical fit to the data, these effects are consistent across random sub-samples, allowing a measure of confidence in concluding that these effects are likely to be key in the development of any hypothesized strategy. The robustness of these effects is conceptually meaningful and thus as desirable as statistical parsimony. A brief discussion of this model's conceptual implications follows.

The modified model indicates that *Father Absence* can act as an important mediator between environment and behavioural expression. Family breakdown is associated with ecological factors indicative of scarce resources. Unemployment makes it harder for parents to provide for themselves and children, increasing familial stress levels and marital discord. Financial difficulty, economic instability and welfare dependency have all been shown to be common predictors of intimate partner violence, divorce or union dissolution (Cunradi et al, 2000; Diem & Pizarro, 2010; Lewin, 2005; Lichter, Qian & Mellott, 2006; Weaver, Sanders, Campbell & Schnabel, 2009). An increase in population density (especially in an area of already limited resource) exacerbates these stress levels, as competition increases. A negative sex-ratio is also associated with family breakdown (Guttentag & Secord, 1983; Barber, 2000a, 2000b). When women are abundant, men find it easy to move from mate to mate, reducing parental investment in offspring, increasing the number of female-headed

households and implicitly conveying to children that monogamy and paternal provision are not expectable. This complements the existing body of research on the long-term effects of father absence (Draper & Harpending, 1982; Belsky et al., 1991) and is consistent with Belsky et al's. proposal that family breakdown accelerates life history strategy. The effect of life expectancy on family stability is also important, thus supporting Chisholm's later additions to the model. External cues to morbidity and mortality may be sufficiently stressful to disrupt the attachment process. These findings also generally support Chisholm's proposals that perceptions of mortality can be transmitted through the family unit to developing children, who then adopt faster LH strategies calibrated to suit local environments. The significant effect that *Father Absence* has on strategy is testimony to the clear mediating role that the familial environment has on levels of expression of socially undesirable behaviours.

The mediating role of *Father Absence* is only one of three effects on strategy development, with *Education* and *Life Expectancy* being equally significant. These results suggest that direct perception of environmental cues can foster the speed of individual life history trajectories. Education is a strong and direct determinant of strategy-based behaviour. As discussed earlier, education levels have been linked to both aggression and early pregnancy. Better education usually leads to better employment prospects, greater opportunities in the future and improved financial stability (Kaplan & Gangestad, 2004). From this perspective, education could be yet another scarce resource in the environment to which individuals are sensitive. In most western societies, children from as young as four years old spend many hours a day in an educational context. Child development studies have consistently shown that the educational context is likely to be of equal importance in child development and wellbeing as family, peer and neighbourhood environments (Brofenbrenner & Morris, 1998; Oberle, Schonert-Reichl & Zumbo, 2011; Theokas & Lerner, 2006; Youngblade & Curry, 2006). In educationally rich settings, children acquire skills that help them to maximise future reproductive and resource-accruing potential, and equip them for competition. Such individuals are less likely to resort to violence and less likely to advance their reproductive schedules. Individuals experiencing educational deprivation would be expected to show the opposite pattern. The effect of poor education on teenage conceptions may also be to reduce career opportunities and enhance the attractiveness of motherhood. Younger mothers are more likely to have disliked school (Haldre, Rahu, Rahu & Karro, 2009), spent fewer years in school (Hofferth, Reid & Mott, 2002), or to have dropped out altogether (Heavey, Moysich, Hyland, Druschel & Sill, 2008). Several studies have noted that the desire for motherhood is stronger in young girls in deprived areas (Geronimus, 1992). Making rational (although possibly unconscious) decisions about accelerating reproductive schedules is critical to strategy development and is driven by making assays of one's life expectancy. Geronimus (1996) claimed that early-reproducing girls who "face not simply a shorter, but a far more uncertain lifespan.....may be planning for the kind of future they have every reason to expect" (Geronimus, 1996:346). Recent evidence on British girls (Nettle, Coall & Dickins, 2010) indicates that an intention to reproduce early was predictive of actual early reproduction, and that young women in poorer socioeconomic circumstances who desired early reproduction were more likely to have received lower levels of paternal investment. Teenage conception rates may also be affected by levels of education more directly through contraceptive education. Adolescent sexual decision-making can be based on insufficient or incorrect knowledge about sexual health and sexual practices (Gage, 1998; Kozinszky & Bártai, 2004; Paukku, Quan, Darney & Raine, 2003; Santelli, Morrow, Anderson & Duberstein Lindberg, 2006). It is impossible to determine from this data however whether

desire for motherhood or lack of contraceptive knowledge plays the bigger part in increasing the rates of teenage conceptions and future work is required to separate their effects.

Life expectancy shows an interesting pattern of results, acting directly and indirectly on strategy development. It not only contributes to family breakdown; it can directly affect strategy development independent of family circumstance. Developing children may suffer from the stress of their parent's reaction to shortened life expectancy (Chisholm, 1999a), but they may also be making their own assays of their life expectancy through direct experience of their environment (Daly & Wilson, 1997; Ellis et al., 2009). Precisely how mortality assays are made is unclear. It may be that individuals are directly sensitive to the frequency of critical environmental events such as natural disasters or famine. Pathogen sensitivity may also be important. Data show that levels of disease prevalence are related to violent behaviours toward partners and children (Thornhill & Fincher, 2011) and to measures of sociosexuality (Schaller & Murray, 2008). Evolved pathogen sensitivities may therefore play a part in mortality assays. Alternatively or additionally, individuals may be estimating the likely length of their own life by observing the people around them. An individual in an environment who seldom comes into contact with aged individuals may conclude (consciously or unconsciously) that they themselves cannot expect to live to old age (Mishra & Lalumière, 2008). Cues to environmental danger may also be important. Johns (2011) demonstrated that the odds of teenage motherhood increased in line with young women's belief that the environment in which they lived was dangerous. Similar results were found by Upchurch, Aneshensal, Sucoff and Levy-Storms (1999). This suggests that a construct such as the unpredictability schema suggested by Ross and Hill (2002) may be a psychological mechanism that catalogues such information from the environment. Perceptual mechanisms aside however, cues to mortality are clearly one of the most important determinants in shaping life history trajectories: studies which have asked respondents to estimate their likely age of death have found significant associations with life history variables (Burton, 1990; DuRant et al., 1997).

Violence, unlike early pregnancy, has two direct links that are independent of strategy: *Number of Youths* and *Population Density.* This link is the only significant effect of *Number of Youths* in the model. High numbers and density of youths in the locality (who are more violence prone than their elders, Daly & Wilson, 1985) present an increased likelihood and intensity of direct conspecific competition. Individuals are more likely to be involved in violent altercations simply by being amongst greater numbers of individuals with similar resource needs. This can create a violence spiral with proactive aggression being used to ward off attackers, as well as increased use of defensive aggression. It is therefore feasible that some facets of the environment represent a form of "local enabling circumstance" that may inhibit or exacerbate the expression of some life history traits but not others. Future research will hopefully highlight which other facets of the environment (if any) have similar effects on behaviour.

The revised model also clearly highlights the importance of the potentially additive effects of ecological variables. *Life Expectancy*, *Education* and *Population Density* each affect multiple levels of the model. This suggests that these variables are especially important due to their cumulative effects. Belsky et al. (2011) demonstrated a similar additive effect in a longitudinal study of 1,364 families. Indicators of environmental unpredictability (such as parental transition, household movement and parental employment

transition) were significantly related (both directly and indirectly) to early and late symptoms of maternal depression, maternal sensitivity (a proxy for attachment) and sexual precocity of children aged 15. However environmental harshness (indexed by an income to needs ratio) had no significant direct effect upon sexual precocity. The impact of some ecological factors on LH strategies can therefore be enhanced by their impact on multiple pathways.

Limitations

Several limitations of the study should be noted. Firstly, Female Lone Parents is an imperfect and incomplete measure of the family environment and *Father Absence*. At the level of local authority data, only structural variables are recorded (divorce rates, household composition, etc). This variable does not take into account the addition of subsequent partners to the family unit or possible investment from other sources. It could be argued that this variable in itself is an indicator of strategy selection that might be transmitted to offspring genetically or culturally, as well as acting as a proximal environmental cue. In future research, in addition to structural variables, measures of childhood attachment would provide meaningful psychological indicators of family climate and stability.

Recent research suggests other variables that might usefully be incorporated in future studies. Nettle et al. (2010) demonstrated that low birth weight uniquely contributed to the prediction of early reproduction, alongside paternal investment and indicators of socioeconomic status. Additionally, research also demonstrates that most behavioural and psychological traits linked with LHT show degrees of heritability (Bouchard, 2004), especially early maturation (Rowe, 2002). It should also be acknowledged that the strong correlations between variables of interest in this study could be a result of covariation of genotypes within communities, as well as shared environmental factors. It is important that future work incorporates biological and ecological factors to fully encompass the developmental environment of individuals.

This study looked at the environment's effect on behaviours at a macro level. Although certainly informative and supportive of previous works in LHT, it should be the aim of further studies to establish if these same relationships exist at the level of the individual. Indeed, by examining the micro level, many of the limitations of this study could be more readily addressed.

To conclude, the results of this study suggest that violent crime and early reproduction represent two behaviours characteristic of an underlying life history continuum and that an individual's position on this continuum may be contingent both directly and indirectly on perceptions of ecological stressors. The family unit as a source of stress is doubtlessly important, but first-hand experience of the environment itself plays a pivotal role in developing strategy based behaviours.

The environment and life history strategies: Neighbourhood and individual-level models

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Abstract

Life history trajectories have been shown to be highly sensitive to local environmental conditions. Using English census data (2001), Copping, Campbell and Muncer (2013a) demonstrated that a suite of ecological indicators impact upon life history strategies (affecting levels of criminal violence and teenage conceptions). Here we replicate the original study using recently published census data (2011) to validate the model. We also examine whether census data from 2001 predict criminal violence and teenage pregnancy outcomes ten years later. Results demonstrated that the proposed model is applicable to both census periods. Predictions of violence and pregnancy rates in 2011 were higher when ecological estimates from 2001 rather than 2011 were modelled. Individuals' perceptions of ecological variables included in the models were also collected from 738 participants. There was a striking concordance between census and individual level data; all but five of the original pathways remained significant. Results highlight the importance of examining different units of analysis and implications are discussed from a life history perspective.

Introduction

Research demonstrates strong correlations between behaviours considered to be socially problematic, particularly between aggression and early reproduction (Celio, Karnik, & Steiner, 2006; Pickett, Mookherjee, & Wilkinson, 2005). Developments in human behavioural ecology and evolutionary psychology (particularly life history theory) suggest that social 'pathologies' can be seen as rational, adaptive choices contingent on ecological circumstances. The conceptualization of local ecologies is often neglected however. This study aimed to empirically validate existing work on how ecological conditions impact on behavioural trajectories. A brief discussion of the theoretical background follows.

Draper and Harpending (1982) demonstrated the significance of stable family functioning, highlighting how later reproductive strategy could be contingent on the earlier presence or absence of a father figure. Belsky, Steinberg and Draper, (1991), developing this model, suggested that father absence per se was not the trigger to later reproductive strategy, but the associated stress caused by that absence. Father absence represents one of many stressors that may disrupt parent-child attachment processes (Bowlby, 1969), conveying information to developing children that their environment is unstable. Children with less secure attachments are expected to develop a mistrustful and opportunistic view of the world, and furthermore, reach puberty earlier. Belsky et al. uniquely predicted that the early social experiences of children would contribute to determining the end point of

somatic growth. This foreshortening of childhood would be associated with expectations of a harsher future, tendencies to act in a mistrustful, opportunistic way and sexually precocious behaviour. This theory is now often referred to as psychosocial acceleration theory.

Chisholm (1993, 1999) advanced psychosocial acceleration theory by integrating it with principles drawn from life history theory. Life history theory suggests that organisms invest resources in growth and reproduction within finite parameters, necessitating a series of trade-offs. Organisms can begin reproduction early despite being in a sub-optimal position in terms of resource availability (be it somatic or in those available for future expenditure (such as wealth or status). Doing so increases the length of their reproductive window and their potential number of offspring. Alternatively, organisms can delay reproduction and favour growth, allocating time to acquire resources for parenting but reducing the reproductive window. The switching point between growth and reproduction is often referred to as the general life history problem (Schaffer, 1982). Chisholm proposed that assays of one's mortality determine this switching point. Parents rearing children in difficult or 'uncertain' environments (e.g. single parenthood) are subject to stresses that disrupt parent-child attachments. Attachment disruption is internalised in the child as an expectation of an uncertain future with high mortality risks, causing developing children to advance their reproductive schedules and adopt strategies consistent with living fast and dying young. This increases the propensity for the expression of behaviours such as sexual precocity and aggression. Chisholm proposed that "uncertainty" in the environment was the ultimate cause of violence and teenage pregnancy and that these behaviours are adaptive survival responses aimed at avoiding lineage extinction in sub-optimal conditions.

Incorporating work on father absence and attachment dysfunction into his concept of environmental uncertainty, Chisholm claimed "ultimately, universal sources of parental stress are the routine social and environmental causes and correlates of high mortality rates—poverty, exploitation, hunger, disease, and war and their accompanying fear and hopelessness" (Chisholm 1993:7). Many studies demonstrate links between early stress, family breakdown, life expectancy, aggression, earlier sexual debut and earlier menarche (Belsky et al., 2012; Chisholm, Quinlivan, Peterson, & Coall, 2005; DuRant, Cadenhead, Pendergrast, Slavens, & Linder, 1994; Ellis & Essex, 2007; Gibson & Tibbetts, 2000; Wilson & Daly, 1997). The role of the family unit as a mediator between environmental stress and expressed behaviour is well supported. Ellis, Figueredo, Brumbach and Schlomer (2009), whilst supporting the pivotal role of family environments, emphasised the importance of direct perception of environmental stressors They argued that evolved sensitivities to ecological mortality cues uniquely contribute to behavioural outcomes alongside the influence of familial stress. Individuals internalise ecological information about the relative predictability of local conditions and organisms within it into statistical composites (Wilson & Daly, 1997). This composite is then used to regulate future strategic behaviour. Because environmental cues are intercorrelated and operate on multiple levels, organisms consider environments holistically; knowing one facet alone cannot predicate strategy development. Ellis et al. (2009) suggested that factors such as exposure to conspecific violence, low socioeconomic status, poor parental investment and poor heath represented cues potentially forecasting premature death or disability, thus impacting on strategy development. Many studies support this multi-level perspective onf the environment (Belsky, Schlomer & Ellis, 2012; Brumbach, Figueredo & Ellis, 2009; Simpson, Griskevicius, I-Chun Kuo, Sung, & Collins, 2012).

Copping, Campbell and Muncer, (2013a) used structural equation modelling (SEM) to compare two models. One model was based on the family as a mediator between the environment and an individual's strategy, while the other model incorporated direct environmental effects as well as indirect effects via the family. English census data (2001) was used to represent environmental factors potentially impacting upon local crime rates and teenage conceptions. The study demonstrated that a model with multiple levels of impact (on the family, overall strategy and specific behaviours) was the best predictor of crime and pregnancy rates at the level of the environment (indexed by local authorities). They concluded that, whilst the family unit was undoubtedly crucial (supporting Belsky et al., 1991; Chisholm, 1993, 1999a), strategy could be influenced directly by environmental cues (supporting Ellis et al., 2009). Levels of overt behaviour (aggression in particular) were susceptible to the direct effects of certain environmental factors, particularly those regulating exposure to conspecifics such as the number and density of the youthful population (termed "local enabling circumstances").

Current studies

This model was useful in identifying relationships between environmental factors and behaviours of interest, and provided a basis for exploring perceptible environmental cues at the individual level. There were however several avenues for further investigation and some methodological limitations. This study aimed to expand on the original work by addressing the following issues.

The cross-sectional nature of the original data limits interpretation. All relationships represented localities at a single point in time. Psychosocial acceleration theory however predicts that stress throughout early development (specifically around age 5) should impact the expression of strategy across adolescence (10-15 years later); the onset of adrenarche and the transition to adolescence being the key developmental milestone (Del Guidice, 2009a; Del Guidice & Belsky, 2010). Without data from two time points, the predictive validity of the model cannot be established. The release of the 2011 census data afforded the opportunity to replicate the original model on comparable data whilst demonstrating predictive validity in forecasting strategy behaviours in 2011 from data in 2001. The original model specification should demonstrate comparable statistical parsimony using the new data. In addition, if this model validly expresses trajectory development, environmental indicators from 2001 should be more predictive of strategy related behaviours in succeeding years rather than concurrent years. The analysis of these two waves of census data is presented in Study 1.

Furthermore, relationships demonstrated on macro neighbourhood levels, whilst informative, cannot be translated automatically to micro levels as correlations studied at group level are not necessarily reflected at the level of the individual (the "ecological fallacy"; Robinson, 1950). Mapping environmental correlates to individual life history strategies therefore requires a study that can mirror these variables at an individual level. Our original model was constructed on the premise that the local ecology impacts on behaviour because elements of the environment are perceived and processed by an as-yet-unknown psychological mechanism. These perceptions then affect the development of life history trajectories (Chisholm, 1999; Ellis et al., 2009; Wilson & Daly, 1997). Whilst many studies propose factors that contribute to stressful environments, there is one crucial gap in the literature. Little effort has been made to explore individuals' actual sensitivity to such factors in their local environments. For example, our earlier model supported previous findings that sex ratios,

density and high youthful populations significantly affect strategy-driven behaviours (Guttentag & Secord, 1983; Land, McCall, & Cohen, 1990). But do individuals consciously detect this information (particularly, subtle factors such as sex ratio)? Only the study of individuals can determine whether and how such information is perceived and this should be an important research direction. Study 2 moves from macro to micro level analysis regarding the key model components. A general theory of behaviour that encompasses structural covariates should be capable of accommodating all levels (regardless of the size of the unit of analysis; Land et al., 1990) and life history theory should be no exception. Data was therefore collected to examine individual perception of key variables from the Copping et al. (2013a) model and how they impact upon self-reported strategy based behaviour.

Study 1

Method

Data was taken from the English National Census (2001; 2011). Local authorities are responsible for administering local education, health and government services, representing the smallest unit of analysis available to gather all necessary data whilst sensitively representing local environments. In the original study, 339 such authorities were analysed[10]. Between census periods however, local authorities were reorganised in areas of England. Consequently, only 291 local authorities were available for analysis from the 2011 census. Data was merged from authorities in 2001 and recalculated making them comparable with authorities in 2011.

Census measures

Variables from the original study were implemented in this replication (see Copping et al., 2013a for conceptual justifications). Where calculation changes were made, they are described. The following independent variables were measured.

Number of Youths: The number of 15-29 year old males and females were summed and calculated as a rate per 1000 of the local authority population.

Youth Sex Ratio: The ratio of reproductively fit males to females was calculated as the number of males per 100 females in the age range of 15-29.

Father Absence: This was indexed by calculating the rate per 1000 of female lone parents[11].

Education: Education was originally assessed using a latent measure derived from KS3 English, Maths and Science data (achievement at approximately age 14). Changes to government education policy between census periods prevented comparable data in 2011. Education was therefore measured by examining the percentage of children achieving level 4 or above in English and Maths at KS2 (approximately age 11) as this was the only

[10] 13 authorities excluded from the original work remain so owing to differences in administration.
[11] Does not exclude families with other investment sources (including fathers or other males) or stable mother-only environments.

measure common to both census periods. As latent variables cannot be constructed from just two items, the average was taken and is now represented as an observed rather than a latent variable in the models.

Unemployment: The rate per 1000 of registered job seekers aged 18 to 65 was taken for each authority.

Life Expectancy: Originally, disability free life expectancy from birth was used as a mortality index. This measure was not calculated in 2011. Standard life expectancy from birth estimates were used instead to allow comparison across the period.

Population Density: The number of people per hectare.

The following dependent variables were measured.

Teenage Conception Rate: The rate of conceptions (not births) per 1000 females between ages 15-17[12].

Victimful Criminality: Crimes from the following categories were summed and converted to a rate per 1000 of the total adult population: violence against the person, wounding or life endangering acts, other wounding offences, harassment and penalty notices for disorder and common assault[13].

Results

Descriptive statistics and correlations are presented in Table 12. Correlations were calculated on the 2001 and 2011 samples separately and compared. Descriptives are presented for each census period. Because correlations for the 2001 census were recalculated on the 2001 and 2011 samples separately and compared. Descriptives are presented for each census period. Because correlations for the 2001 census were recalculated based on the modified variables resulting from administrative changes, they are not identical to those presented in Copping et al. (2013a).

Correlations between *Teenage Conception Rate* and *Victimful Criminality* were still moderate and in the expected direction (r = .64/.61). Intercorrelations between all variables were significant ($p<.01$) and in predicted directions unless stated otherwise. A small number of the correlations differed significantly ($p<.05$) across census periods, but the majority were consistent over time.

Model replicability

The first objective was to confirm the model proposed by Copping et al. (2013a) on the 2011 data set. This was tested using SEM and by modelling as depicted in Figure 8. An ellipse represents life history strategy with dependent variables loading onto it. Observed variables are represented by rectangles. Residual error and intercorrelations between predictors were assumed but are omitted from diagrams for clarity. Models were generated using Maximum Likelihood Estimation.

[12] Whilst pregnancy is possible at earlier ages, this information is confidential and unobtainable from local authorities. Actual rates may be higher than those presented.
[13] Homicides are not included as they are not recorded on local levels.

Table 12: Correlations and descriptives (2001/2011)

	Violence	Pregnancy	Life expectancy	Education	Unemployment	Father absence	Population density	Number of youths	Youth Sex Ratio
Pregnancy	.64/.61								
Life expectancy	-.61/-.56	-.80/-.77							
Education	-.58/-.53	-.72/-.56*	.53/.41						
Unemployment	.56/.56	.74/.75	-.81/-.81	-.54/-.45					
Father absence	.61/.62	.78/.76	-.80/-.85	-.56/-.42*	.81/.88				
Population density	.58/.70*	.57/.50	-.48/-.47	-.50/-.32*	.48/.57	.58/.60			
Number of youths	.44/.68*	.46/.46	-.43/-.50	-.48/-.35	.37/.49	.40/.55*	.65/.69		
Youth sex ratio	-.26/-.26	-.43/-.29*	.41/.24*	.26/.08 *	-.35/-.32	-.44/-.32	-.26/-.25	-.10/-.13	
Mean (2001)	29.71 α	39.00 α	78.67 Ω	74.84 Ψ	20.01 α	65.08 α	9.99 π	174.90 α	103.06 β
SD (2001)	15.33 α	13.13 α	1.35 Ω	5.03 Ψ	11.50 α	19.98 α	10.91 π	31.45 α	7.16 β
Mean (2011)	25.03 α	29.43 α	81.14 Ω	81.33 Ψ	29.85 α	56.90 α	10.69 π	182.75 α	103.81 β
SD (2011)	9.87 α	9.94 α	1.44 Ω	3.77 Ψ	12.79 α	14.70 α	11.87 π	35.91 α	8.34 β

*correlations differ significantly, p>.05, $^{\alpha}$ rate per 1000, $^{\Omega}$ years, $^{\Psi}$ percentage, $^{\pi}$ people per hectare, $^{\beta}$ males per 100 females

Table 13: Model Comparisons

Model	N	X^2	DF	X^2/DF	P	RMSEA	CFI	Crime r^2	Pregnancy r^2
2001	291	14.48	9	1.61	.11	.05	.99	.53	.82
2011	291	39.14	9	4.35	.000	.10	.98	.66	.77
Combined	291/291	204.00	44	4.64	.000	.08	.96	.40	.81

Model validity was tested in two ways. Firstly, a model for each census period was created to determine statistical fit on each sample. Secondly, a model with fixed linkages across both samples was tested (allowing data to be compared assuming relationship invariance). Table 13 shows model fit statistics.

The model remained a good fit for the 2001 data, and adequately fitted the 2011 data. The model assuming fixed relationships was also parsimonious. Whilst X^2 values were significant in two of the models, it must be noted that this is sensitive to sample size and strong inter-item correlations (Kline 2005). Fit statistics therefore validated the original model. Figure 8 illustrates coefficients for the model with fixed linkages (representing both samples). All links were significant ($p<.01$).

The second aim was to examine the predictive ability of the model over time. Do developmental environments in 2001 predict crime and teenage conceptions in 2011? This was modelled using environmental variables from the 2001 census to predict dependent variables in 2011. The model was evaluated as before, and model coefficients are given in Figure 9.

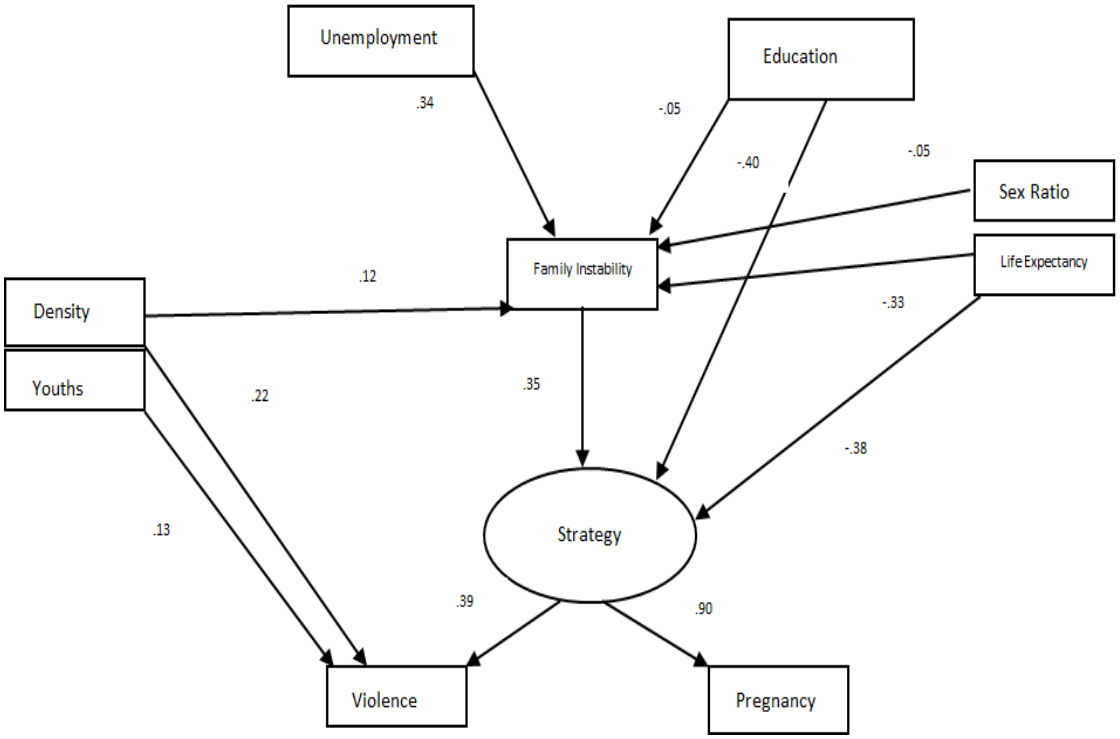

Figure 8: Copping et al., (2013) model with fixed linkages across samples from 2001 and 2011 (*N=582*)

Predictive validity

Statistics indicated that the model fitted adequately to the data (df = 9, X^2 = 36.96, p<.01, X^2/df = 4.12, CFI = .99, RMSEA = .10). In predicting variance in the dependent variables, this model had r^2 values of .67 for *Victimful Criminality* and .85 for *Teenage Conception Rate*. These values were higher than in the models

restricted to data from single census years. All links in the model were significant with one exception (*Education* and *Female Lone Parenting*, p>.05).

To further validate this effect over time, this model was conceptually reversed and compared to the previous analysis. In order to demonstrate that reversing the temporal order of events produced a less parsimonious fit, the independent variables from 2011 were used to predict dependent variables from 2001. Results indicated this model did not adequately fit the data (df = 9, X^2 = 52.40, p<.01, X^2/df = 5.82, CFI = .98, RMSEA = .13) and was significantly worse than the original (X^2_{diff} = 15.44, df_{diff} = 0, p<.001). Several links were also no longer significant. Results suggest that the proposed model is potentially indicative of a developmental pattern.

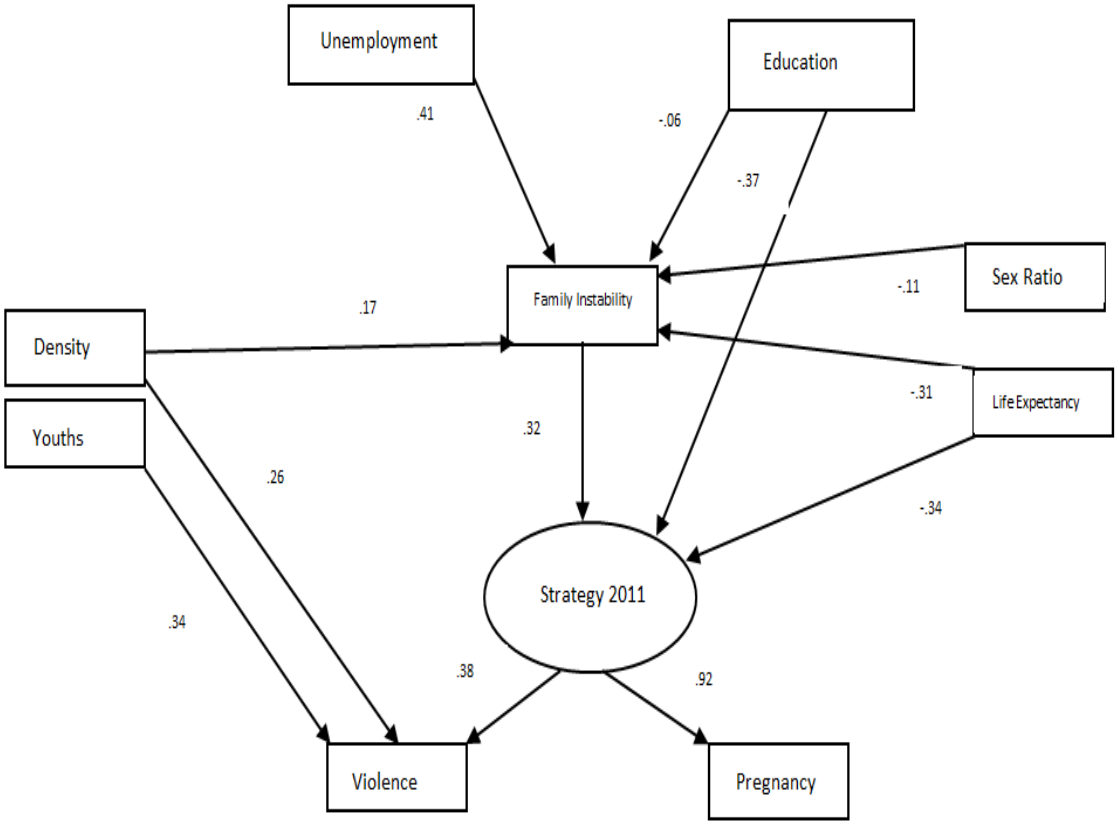

Figure 9: Model predicting outcomes in 2011 from stressors in 2001 (*N=291*)

Discussion

Study 1 demonstrates that the original model of environmental effects on behaviours is replicable when applied to local authority data across two census collections. The similarity of correlations between variables across censuses suggests these relationships are stable over the period, demonstrating that the proposed model (Copping et al., 2013a) has strong validity over time.

Behaviour was more strongly predicted by indices from ten years previous than the concurrent year. Psychosocial acceleration theory predicts that the developmental environment is critical in determining strategy

trajectories (Belsky et al, 1991; Chisholm, 1993). These findings support the notion that environmental circumstances have long-term behavioural consequences. In the original paper, children developing under the modelled conditions were entering the critical phases of development (such as puberty Del Guidice, 2009; Del Guidice & Belsky, 2010) and in 2011 would be entering the 15-29 year old age group; the group responsible for teenage pregnancies and much of the victimful criminality rate (Land et al., 1990; Steffensmeier, Allan, Harer & Streifel, 1989; Wilson & Daly, 1985). Whilst this interpretation cannot be considered conclusive from census data, it provides support for psychosocial acceleration theory and demonstrates that its proposals can be observed over time on a macro level. The fact reversing the model was a significantly worse fit than a temporally predictive model allows a measure of confidence that this finding is not spurious. Causality cannot be truly established in correlational data however and this study represents the closest approximation to a longitudinal test of psychosocial acceleration theory using census data only.

Study 2

The aim of Study 2 was to examine whether a model constructed on neighbourhood level (census) data would fit data derived from individuals' self-reports of direct perceptions of their neighbourhoods.

Method

Cross-sectional sample and measures

Data were collected using an online questionnaire examining variables of interest (detailed below). Participants were recruited opportunistically though social networking sites, secondary school and college recruitment and university participant pools. No exclusion criteria were implemented except that participants had to be at least age 13 (for ethical reasons). Seven hundred and thirty eight participants provided useable data with an age range between 13 and 69 (303 males, mean age 16.11, SD 5.14; 435 females, mean age 17.50, SD 6.32). The following independent variables were assessed.

Number of Youths: Participants indicated on a four-point likert scale whether individuals in the local area were predominantly young or old. Higher scores indicate that neighbourhoods were predominantly youthful.

Population Density: Participants indicated on a four-point likert scale how crowded they felt their local neighbourhood was. Higher scores represent denser populations.

Youth Sex Ratio: Participants indicated on a four-point likert scale whether they noticed that their neighbourhood had more females than males. Lower scores represent environments with more females.

Family Instability: To try and capture the dimensions of family instability in detail, participants completed a 15 item questionnaire assessing four domains: discipline (three items examining consistency of disciplinary action taken during childhood, $\alpha = .60$), family mobility (four items examining frequency of movement to different jobs, schools, homes and the movement of new individuals in and out of the family unit, $\alpha = .68$), meal provisioning (four items examining healthiness, consistency and availability of meals, $\alpha = .67$) and attachments (four items examining time spent with and closeness to parents, $\alpha = .83$). Whilst three of scales had low alpha

values, Confirmatory Factor Analysis (CFA) demonstrated that all scales were acceptable fits to the data (X^2 >.01, CFI >.96, RMSEA <.10 in all cases). As these latent variables represent dimensions of family instability, all four were loaded onto a higher order factor for the purposes of the model. CFA again confirmed the higher order construct was a good fit to the data (X^2 <.01, CFA = .93, RMSEA = .06) despite a now significant X^2 value (likely attributable to the large sample and strong variable intercorrelations; Kline, 2005).

Unemployment: Perceiving unemployment directly as a proxy for economic decline is difficult as 'unemployment' itself is not a perceptible physical characteristic. Due to difficulties in measurement whilst balancing the need to include this in the model, postcode data (supplied by the respondents) was used to ascertain the number of unemployed individuals in the immediate area. Employment data is recorded in the same database as census material and can be extrapolated to what the UK government define as an 'output area'. This area covers a small geographical area (usually only three or four streets) and therefore covers the immediate environment to an individual's dwelling. The number of unemployed people in each area was expressed as percentage to control for different population sizes in each area.

Education: Measuring individual education level across age groups is difficult because different levels and stages are not comparable in the English education system. This makes a meaningful measure impossible without the administration of a standardised test (which was not possible in this study). Nevertheless, education has been highlighted as an important predictor of strategic behaviour and should be included. Thus, individuals in an 'output area' (corresponding to postcode) who reached at least level 2 (any General Certificate of Secondary Education at grade C or above at age 16) was expressed as a percentage of all individuals in the local environment.

Life Expectancy: Participants were asked to estimate the age (in years) to which they expected to live.

The following dependent variables were assessed.

Aggression: Participants completed the Richardson Conflict Response Questionnaire (RCRQ; Richardson & Green, 2003). Participants self-reported the frequency of various aggressive activities they had engaged in over the past year using a five-point likert scale. Positive scores represent more aggressive tendencies. As this represents a latent variable in SEM, the validity of the construct was established using CFA. Five items from the RCRQ best represented the construct of aggression (X^2 >.05, CFI .99, RMSEA, .03). The scale reliability was high (α = .91).

Attitude to Mating: As this study recruited young adolescents, it was ethically inappropriate to measure sexual behaviour directly. As a proxy, attitudes towards sex and relationships were assessed. Participants rated their agreement on items assessing attitudes to casual sex, long-term commitments and short-term relationships using a likert scale. Positive scores represent attitudes favouring short term relationships. Like aggression, this variable was represented as a latent trait in SEM and was therefore validated using CFA. A four item scale provided a reliable measure with a good fit to the data set (α = .76, X^2 >.01, CFI .99, RMSEA .07).

Results

Table 14 presents descriptive statistics and correlations between variables. Of the 36 significant relationships in the macro level data (Table 12), 19 were reflected in the micro equivalent, albeit more weakly, and were in the same direction as those from the census data. In general, the correspondence between macro and micro level data was substantial.

Figure 10 represents the census-derived structural model applied to these data. For clarity, the model is displayed in a manner similar to macro models in Study 1 for the purposes of comparison. Linkages represent standardised beta weights. Statistically, when applied to individual data, the model was a good fit (df = 380, X^2 = 856.04, X^2/df = 2.25, CFI = .93, RMSEA = .04). There were differences between this model and the macro level equivalent however. Of the 12 pathways, five were non-significant (p>.05) in the micro level model (*Unemployment* to *Family Instability*, *Life Expectancy* to *Strategy*, *Education* to *Strategy*, *Number of Youths* to *Aggression*, *Density* to *Aggression*). The r^2 values for aggression and attitude to mating were lower than the equivalent census-based values for victimful criminality and teenage pregnancy rates, r^2= .25 and .40 respectively (r^2 in the census models were .53/.82 in 2001 and .66/.77 in 2011 respectively).

Discussion

In Study 2, the macro models were validated against equivalent data collected from individuals. This is important because conclusions from macro data alone prohibit firm conclusions regarding individual life history strategy development (the ecological fallacy). Individual data allow clarification of pertinent environmental facets to which individuals are sensitive and demonstrates their importance in the context of psychosocial acceleration theory. Whilst the model based on individuals was not an exact match to census-based models, similarities between them allow some confidence in the core findings. This finding suggests that the core principles of psychosocial acceleration theory as a general theory for development is observable across multiple units of analysis (Land et al., 1990) and validates the premise that these environmental indices are important in determining strategy trajectory.

Nineteen of the 36 correlations in the individual-level data set were significant in the same direction as in the macro data (although reduced in magnitude). Relationships are also significant in expected directions. Aggression is significantly related to all independent variables except sex ratio, whilst mating orientation is significantly related to all variables except education and unemployment, affirming the fact that these variables are sensitive to environments. In the structural models, seven of the 12 links remain significant between the concurrent/predictive macro models and the individual-level model. Furthermore, the individual level model is more statistically parsimonious despite the non-significant pathways. This supports the high concordance between the macro and micro levels. Generally, the non-significant correlations represented relationships between the measures used for unemployment, education and the remaining variables. The lack of significance is probably attributable to the fact direct measures examining individual's own education or personal economic circumstances were not employed in this study (see general discussion).

Table 14: Table of descriptives and correlations from self-report data (n=738)

	Aggression	STM/LTM	Life Expectancy	Education	Unemployment	Family Instability	Population density	Number of youths	Youth Sex Ratio
STM/LTM	.29**								
Life expectancy	-.14**	-.09**							
Education	-.15**	-.06	.00						
Unemployment	.09*	-.01	.06	-.57**					
Family Instability	.34**	.42**	-.20**	-.09**	.02				
Population density	.13**	.18**	-.07*	-.07*	.01	.30**			
Number of youths	.11**	.11**	-.01	-.03	.01	.22**	.31**		
Youth sex ratio	-.03	-.22**	.03	-.05	-.05	-.13**	-.15**	-.16**	
Mean	5.52	4.01	81.92	36.16	4.65	16.50	1.15	1.32	1.52
SD	5.47	2.79	15.01	14.73	3.24	7.81	.83	.81	.70

**p < .001, *p < .05

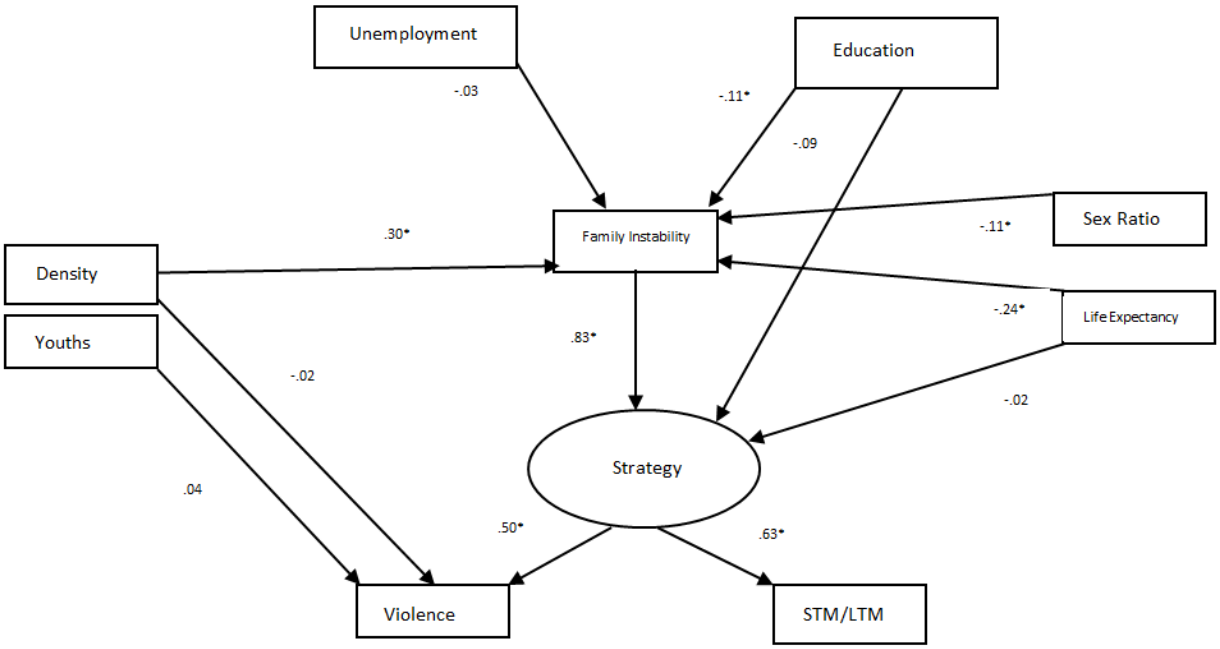

Figure 10: Copping et al. (2013) model applied to individuals

The seven relationships that remain significant between all models reflect the effects of education, sex ratio, life expectancy and population density on family instability, the effects of family instability on strategy behaviours and the relationships between aggression and mating orientation as indices of a latent strategy variable. As these appear significant regardless of level, it allows a strong measure of confidence to be placed on them as stressors relevant to the development of life history strategies. Their implications will be discussed more thoroughly in the general discussion.

The non-significant relationship between unemployment and family instability ($p<.05$) in the individual level data is inconsistent with current literature (Lewin, 2005; Lichter, Qian & Mellott, 2006). Whilst the number of unemployed in an area is a representative indicator of economic insecurity, unemployment has no inherently perceptible characteristics. Measures examining local indices with perceivable manifestations (such as abandoned, dilapidated buildings etc.) may be better indicators. Education, albeit significant in the model, is more weakly correlated in micro compared to macro data and suffers from a similar problem. Nevertheless, both variables were maintained in the model so as to control for potential distal effects on other variables.

The direct relationship between life expectancy and strategy was also non-significant, although life expectancy's relationship with family instability remained significant. Whilst it maintained an indirect effect on strategy through family instability, it would seem that strategy behaviour and predicted life expectancy are not directly linked, supporting Chisholm's (1993) original model of indirect perception of mortality stressors. Whilst previous macro studies show strong correlations between actual local life expectancy estimates and strategy behaviours (Copping et al., 2013a; Low, Hazel, Parker & Welch, 2008; Wilson & Daly, 1997), fewer

studies show the same effects when individuals are asked for their personal estimates of life expectancy. More indirect indices of mortality or threat such as exposure to violence, general health, and measures of pathogenesis (Johns, 2011; Mishra & Lalumière, 2008; Nettle et al., 2012; Upchurch et al., 1999) may be better correlates of strategy and more likely to have the direct effects observed in macro models.

General Discussion

Results from life history studies on macro and micro levels often demonstrate findings consistent with evolutionary theory. In this study, an attempt was made to synthesise data from both levels in order to more accurately identify pertinent developmental stressors which could potentially impact on life history strategy development in the context of psychosocial acceleration theory. Between the micro and macro level models, seven key relationships remained consistent and significant. The conceptual relevance of these relationships will now be briefly addressed.

Family instability remains perhaps the key variable in life history strategy development. Results indicate that instability can take forms beyond father absence (Belsky et al., 1991; Belsky et al., 2012), encompassing multiple facets including discipline and mobility. The impact of general family instability on strategy in the micro model was much larger than that of father absence (used as a proxy for instability in the macro model). In both models, family instability was susceptible to the effects of variation in local population densities. Higher population density makes competition for resources more likely, increasing levels of strain on effective parenting practices. An abundance of females (indexed by negative sex ratios) also strains family stability. A skewed sex ratio means that men are better able to access alternative mates, stretching provisions further, increasing marital disharmony and conveying signals to developing individuals that bi-parental care cannot be relied upon (Barber, 2000a, b; Guttentag & Secord, 1983). An imbalanced sex ratio may drive up the number of lone female parent households and thus increases stress through increased likelihood of father absence (Belsky et al., 1991; Draper & Harpending, 1982). In both models, indices of earlier mortality were significant in predicting the stability of familial functioning. The familial stress associated with lower life expectancies in some environments strongly supports Chisholm's (1999) suggestion that heightened mortality risks support behaviours associated with faster strategies. Finally, the role of education in the stability of families also remains important. Education acts as a gateway into accessing resources and opportunities (Kaplan & Gangestad, 2005) or potentially as a safeguard against pregnancy risks due to insufficient knowledge regarding contraception (Copping et al., 2013a).

Competitive and reproductive behaviours (indexed as criminal violence and pregnancy on macro levels, and as aggression and short-term mating orientations at the micro level) rise and fall together across neighbourhoods and individuals. Whilst correlations are stronger on the neighbourhood level, this is strong evidence to suggest shared aetiological origins, supporting earlier works (Chisholm, 1999a; Copping et al., 2013; Ellis et al., 2009). Whilst the macro and micro measures levels were not identical (the micro measures perhaps representing milder, less socially detrimental expressions of behaviour), the conceptual overlap between them and the strength of these results presents a compelling case for local ecological conditions as being strongly associated with their behavioural expression.

The role of unemployment (indexing local resource shortages) is not conclusive across the two studies. At a macro level, its effects are clearly important. Indices of poverty have been linked to a multitude of behaviours pertinent to this study, including aggression, sexual precocity, mortality and family breakdown (Brewster, 1994; Coulton, Korbin, Su & Chow, 1995; Lewin, 2005; Lichter, Qian & Mellott, 2006; Tan & Quinlivan, 2006; Wilkinson & Pickett, 2009; Wilson & Daly, 1996). The individual level model produced results that were inconsistent with the current literature. This is likely a result of measurement problems discussed earlier. As such, we conclude that resource deprivation is an important stressor in relation to family disruption and therefore life history strategy trajectories. Education is likely to be equally important for similar reasons. Future studies with valid, individual-level indicators of these variables may confirm this conclusion.

Direct effects of density and proportion of youths on aggression were non-significant in the micro model but remain significant in the macro model. Density and number of youths may be distal causes of strategic behaviours that are not perceived directly but, in combination with other factors, set the context for increased expression of aggressive behaviour. These factors may reflect what Copping et al (2013a) call 'local enabling circumstances': circumstances that could directly increase the likelihood of a specific behavioural expression independently of actual strategy trajectory (such as an increasing likelihood of reactive aggression through the increased probability of exposure to conspecific competition). Alternatively, self-report measures of demographic characteristics may not be accurate representations of local conditions. If so, it is possible that their real impact on behavioural outcomes is masked by a mismatch between perception and reality. Research on the perception of neighbourhood characteristics (such as density) suggests that people access them through indirect proxies such as noise, smell, traffic, number of residential buildings etc. (Bergdoll & Williams, 1990; Moch, 1996). Measures employed in this study may not be sensitive enough to accurately reflect perceived densities. Further research is required and firm conclusions about potential density-dependent effects on behaviour cannot be drawn from this data.

Limitations and future directions

The cross-sectional nature of the data gathered from individuals is a limiting factor in this study. A well-designed longitudinal study of children during the key developmental periods identified by psychosocial acceleration theory would be desirable. The use of a macro educational and unemployment variable in this study rather than the individual's own circumstances is also problematic. Future studies should aim to accurately measure these on the individual level and, if this were done, we anticipate that these important variables would have stronger effects on key behavioural outcomes. Future studies could also expand the range of dependent measures to include other potentially pertinent life history variables (such as low birth weights, timing of pubertal onset or theoretically related personality traits). Whilst this is not possible using census data, it could be incorporated into a longitudinal research design and would represent an important validity test for psychosocial acceleration theory. A final limitation is that this study is unable to eliminate the possibility that strong correlations between environmental facets (on the macro level) could be due to genotypic covariation within communities. This is an important consideration as many life history traits demonstrate high levels of heritability (Bouchard, 2004).

Individual's' perceptions of their environment requires further investigation. Self-reported perceptions of demographic factors did, generally, show the expected associations with life history variables (albeit more weakly in magnitude). Exploring the accuracy of people's perceptions of their environment is important for further development of psychosocial acceleration theory and life history theory. If environments are directly or indirectly responsible for developing strategies and if individuals are able to assess these with accuracy, correlations between perceived and actual demographically-induced stress should exist. If not, it raises questions about how individuals perceive and encode environmental 'uncertainty'. Perceptions of local population characteristics (density and sex ratio) would be interesting to examine in further detail, in light of our finding that population density and proportion of youths in the population are significantly associated with levels of violence at macro but not at micro levels. Suggestions have been made as to how ecological data are internally represented including the notion of statistical composites (Wilson & Daly, 1997) and unpredictability schemas (Ross & Hill, 2002). As yet however, firm conclusions on the nature of these representations are not available. Understanding how we map the environment could reveal much about strategy development.

3.4. Further limitations of environmental data

This chapter aimed to explore the cues and stressors individuals may potentially experience in their environments. The macro level analysis identified several variables that may increase family stress as well as directly influencing the expression of life history behaviours. Furthermore, the expansion of this analysis to incorporate individual level perceptions (with the exceptions of education and economic status) provides substantive evidence that these cues are perceived, interpreted and have behavioural consequences. However there are a number of general limitations beyond those noted in Papers Two and Three that need to be addressed regarding this research.

Firstly, neither the macro nor individual-level measures of family instability are actual measures of attachment security (although Paper Three does include a measure of 'closeness' to parents, perhaps akin to emotional attachment). As acknowledged in Chapter One, attachment per se will not be measured specifically in this thesis. Instead, the measures employed are proxies, measuring levels of overall family instability with the individual-level measure in Paper Three encompassing many more sources of family instability than the female lone parenting dimension used in Paper Two. This is important as Belsky et al. (1991) and Chisholm (1993, 1999a) both claim that the attachment bond is a key determinant in the development of life history strategy. The attachment bond is argued to be affected by external threats of mortality and reflects how well the parents can shield offspring from the effects of these stressors. However, they devote little attention to the fact that facets of the family unit itself may act as stressors (or mortality cues) in their own right outside of the attachment bond (although, Belsky et al. (1991) did note that more distally-related family factors may be implicated in disrupting attachment bonds). In Papers Two and Three, we did not distinguish between the actual stress of the family setting (that may impact upon future behaviour) and the levels of indirect stress that may be incorporated into the IWM through a disrupted attachment bond. Some familial circumstances may allow for a secure attachment to a mother and/or father figure, but still allow forms of stress (such as early deaths of kin, sibling rivalries, abusive step parent or extended kin member: Ellis, 2004; Sear & Mace, 2008; Sheppard, Schaffnit, Garcia & Sear, 2014) to act as cues in their own right. This has not been given much consideration, with researchers noting only that secure attachment tends to lead to 'positive' outcomes and slower strategies (Belsky et al. 1991; 2012; Chisholm, 1999a). However, Belsky et al. (2012) in a longitudinal analysis recently demonstrated that environmental unpredictability (indexed by parental moves, job changes and new partners) had a unique impact upon sexual behaviour at age 15 even after controlling for its effects on attachment (indexed by maternal sensitivity). In Paper Three, the family instability variable was created from four latent variables measured by 12 items; meal provisioning, consistency of discipline, family mobility (similar to Belsky et al's (2012) unpredictability dimension) and attachment/closeness (as a proxy for the actual attachment bond). The models including the latent family instability variable (Figure 9) show that it has a strong effect on life history behaviours (r = .83). Table 15 shows the intercorrelations between these four family instability measures and the two life history behaviours. It also shows the partial correlations once the effect of attachment/closeness has been controlled.

Whilst controlling for the proxy attachment measure reduces the size of the correlations between family instability measures and outcome behaviours, it does not wholly nullify them, suggesting that these

indicators of family unpredictability may exert their own independent influences on development outside of the attachment bond (supporting Belsky et al., 2012). These familial stressors, which likely represent Ellis et al.'s (2009) unpredictability dimension, warrant further investigation alongside other potential indicators of external mortality. This is an important consideration as Belsky et al., (2012) note the historical research trend of creating parcelled, cumulative risk factors for the purposes of modelling family circumstances that do not allow consideration of how individual familial risk factors effect individual developmental experiences. Families are complex units and it would be useful to explore their dynamics in greater depth in relation to life history strategy development, beyond the attachment bond. To do this, sensitive measures of family harshness and unpredictability will be required (see Ross & Hill, 2002; Ross & McDuff, 2008, for examples).

Table 15: Correlations between indicators of family instability, aggression and mating orientation

Variable (N=738)	Aggression	Mating Orientation
Meal provisioning	.28/.17*	.29/.17*
Consistency of discipline	.24/.17*	.30/.23*
Family mobility	.22/.15*	.34/.26*
Attachment/Closeness	.26/-	.30/-

All correlations significant at $p < .001$, * partial correlation controlling for the effects of attachment

As an index of external mortality risk, life expectancy is perhaps one of the most conceptually confusing variables. Whilst it demonstrates clear relationships with other variables in the direction predicted by Chisholm (1993; 1999a) and its utility has been supported by life history studies (Chisholm, et al, 2005; Nettle, 2010; Wilson & Daly, 1997), the precise nature of what it represents remains unclear. In this thesis, it is used as a proxy for any source of mortality not encompassed by other variables in the model. However, recent works by Nettle et al. (2013) and Rickard et al. (2014) have proposed a role for internal cues to mortality, claiming that these cues exert a stronger influence on strategy formation than external sources. It is not possible to distinguish whether subjective estimates of life expectancy reflect external mortality risk (such as conspecific violence or ecological threats) or whether they result from internal assessment of the soma, whereby unconscious consideration of the body's physical condition generates estimates of remaining lifespan. Alternatively, measures of life expectancy could be a summation of both internal and external morbidity and mortality factors. In light of recent work, this variable's conceptual significance is likely to be debated and so interpretations drawn from it must be made with caution.

The studies conducted within this thesis scratch the surface of conceptualising "the environment". As noted earlier, the complex interplay of related contexts, people and places (as in Broffenbrenner's (1979) model, for example) means that the developmental environment is difficult to measure effectively and comprehensively. In life history research in particular, the concept of the environment tends to be quite general in its descriptions and classifications of stressors and their effects (e.g. Chisholm 1999a; Ellis et al., 2009;

Nettle et al., 2013). Whilst simplifying the environment into broader classifications (such as uncertainty, unpredictability, harshness etc.) are useful devices for driving theoretical exploration, they create a number of measurement problems. Even leaving aside gene-environment interactions (addressed in the final chapter), environments are multifaceted in nature and it is exceptionally difficult to encompass objective features, subjective interpretation, proximal and distal factors, as well as sociocultural and personal experiences (see Nicotera, 2007 for a review of what constitutes "the neighbourhood"). Capturing all of these elements is easier in principle than in practice, making a comprehensive assessment difficult if not impossible to accomplish. It must therefore be acknowledged that attempts to encapsulate the environment in this thesis are exploratory at best despite our best efforts to combine structural census data with corresponding subjective, personal experiences.

3.5. Chapter conclusion

Despite the limitations raised throughout Paper Two, Paper Three and the chapter as a whole, there is enough evidence to suggest that environmental stressors highlighted in previous research exert effects on aggressive and reproductive behaviour. These effects are evident at the level of society and the individual. These effects, whilst consistent with Ellis et al's (2009) model of direct and indirect perception of stressors, also substantiate the claims of Belsky et al., (1991) and Chisholm (1993; 1999a) that the family unit is perhaps the most critical factor that informs future strategy in developing individuals. The fact that many factors have been modelled together creates an interesting window into potential developmental pathways and constitutes a novel contribution to the research literature. The findings of this chapter will be used to inform the models tested in Chapter Five in which a holistic examination of psychosocial acceleration theory will be attempted.

CHAPTER FOUR

The Concept of Time Preference

4.1. Introduction

This chapter focuses on the psychological mechanisms involved in the development of reproductive strategies. Chisholm (1999a), termed this mechanism "Time Preference". In this chapter, the focus is on what this trait represents psychologically, its adaptive significance and the role played by biological sex. The question: Is "time preference" a unified construct, will also be addressed. Papers Four[14], Five[15] and Six[16] provide empirical evidence to justify the conclusions at the end of this chapter.

Paper Four provides a general introduction to the topic of impulsivity and its conceptualizations over time, as well as exploring sex differences and their basis.

Paper Five investigates the possibility that impulsivity and sensation seeking are conceptually and empirically dissociable in relation to facets of reproductive behaviour.

Paper Six explores the concept of "time preference" specifically in relation to four impulsivity traits and several key life history variables. The possibility of a unitary, higher order construct is also explored.

A very brief summary of the chapter will follow Paper Six. The key empirical findings will be carried over into Chapter Five and much of the theoretical discussion will be elaborated upon in Chapter Six.

[14] Cross, C.P., Copping, L.T., and Campbell, A. (2011). Sex differences in impulsivity: a meta-analysis. *Psychological Bulletin*, 137, 97-130. doi: 10.1037/a0021591

[15] Copping, L.T., Campbell, A., and Muncer, S. (2013). Impulsivity, sensation seeking and reproductive behavior: A life history perspective. *Personality and Individual Differences*, 54, 908-912. doi:10.1016/j.paid.2013.01.003

[16] Copping, L.T., Campbell, A., and Muncer, S. (In Press). Conceptualizing time preference: A life-history analysis. *Evolutionary Psychology*, 12.

Sex differences in impulsivity: A meta-analysis

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Abstract

Men are over-represented in socially problematic behaviours, such as aggression and criminal behaviour, that have been linked to impulsivity. We organize our review of impulsivity around the tripartite theoretical distinction between reward hypersensitivity, punishment hyposensitivity, and inadequate effortful control. Drawing on evolutionary, criminological, developmental, and personality theories, we predicted that sex differences would be most pronounced in risky activities with men demonstrating greater sensation seeking, greater reward sensitivity and lower punishment sensitivity. We predicted a small female advantage in effortful control. We analyzed 741 effect sizes from 277 studies, including psychometric and behavioural measures. Women were consistently more punishment sensitive (d = -.33), but men did not show greater reward sensitivity (d = .01). Men showed significantly higher sensation seeking on questionnaire measures (d = .41) and on a behavioural risk taking task (d = .36). Questionnaire measures of deficits in effortful control showed a very modest effect size in the male direction (d = .08). Sex differences were not found on delay discounting or executive function tasks. The results indicate a stronger sex difference in motivational rather than effortful or executive forms of behaviour control. Specifically, they support evolutionary and biological theories of risk taking predicated on sex differences in punishment sensitivity. A clearer understanding of sex differences in impulsivity depends upon recognizing important distinctions between sensation seeking and impulsivity, between executive and effortful forms of control, and between impulsivity as a deficit and a trait.

Introduction

Men engage in impulsive and risky behaviours more frequently than women. They die younger than women and the higher male:female mortality ratio is particularly pronounced for deaths from external causes

(Kruger & Nesse, 2006). Men drive more recklessly with fully 97 percent of dangerous driving offences committed by men (Beattie, 2008; Norris, Matthews & Riad, 2000). Men also have a significantly higher death rate from non-vehicle accidents such as falls, drowning, choking, electrocution, firearm accidents, and fires (Pampel, 2001). Violence-precipitated visits to hospital accident and emergency services are higher among men (Shepherd, 1990). Men are more physically and verbally aggressive than women across data sources and nations (Archer, 2004, 2009; Bettencourt & Miller, 1996; Eagly & Steffen, 1986; Hyde, 1986; Knight, Fabes & Higgins, 1996; Knight, Guthrie, Page & Fabes, 2002). Men constitute 76 percent of all criminal arrests in the United States, committing 89 percent of homicides and 82 percent of all violent crime (US Department of Justice, n.d.). Worldwide, men use drugs (alcohol, tobacco, cannabis and cocaine) more than women (Degenhardt et al., 2008). They participate more often in extreme sports, such as sky diving and mountain climbing (Harris, Jenkins & Glaser, 2006; Robinson, 2008). Men are also more likely than women to suffer from a range of psychopathologies characterized by externalizing and impulsive behaviours such as antisocial personality disorder, conduct disorder, attention deficit hyperactivity disorder, and intermittent explosive disorder (American Psychiatric Association, 2000; Frank, 2000; Gershon & Gershon, 2002; Kessler et al., 2006; Moffitt, Caspi & Rutter, 2001).

In all of these domains, poor impulse control has been invoked as an explanatory variable. Sometimes impulsivity is embedded in a theory or model, but more often it appears as an independent variable in regression analyses along with other plausible explanatory candidates. It is surprisingly rare, however, that sex differences in social and psychological pathologies have been considered in relation to sex differences in impulsivity in society at large. The present study uses meta-analysis to examine whether there are average sex differences in unselected community samples across a range of psychometric and behavioural measures of impulsivity. We also examine whether, in these samples, variance in men's impulsivity scores is greater than women's. Such a finding could explain men's over-representation in extreme and problematic impulsive behaviours. Though men would also be over-represented at the left as well as the right tail of the distribution, a low level of impulsivity is unlikely to attract attention from educational, medical or judicial systems.

Impulsivity: Models, measures, and sex differences.

A terse, broad, and widely-accepted definition of impulsivity is a "tendency to act spontaneously and without deliberation" (Carver, 2005, p. 313). However, the trait is far from unitary and Depue and Collins (1999, p.495) note that "impulsivity comprises a heterogeneous cluster of lower-order traits". There have been a bewildering number of attempts to disaggregate impulsivity into more specific subtypes such as failure to plan (Patton, Stanford & Barratt, 1995), lack of perseverance (Whiteside & Lynam, 2001), venturesomeness (Eysenck & Eysenck, 1985), poor self-discipline (Costa & McCrae, 1992) and novelty seeking (Cloninger, 1987).

In organizing our review of the literature, we focus on theoretical approaches to impulsivity highlighting the extent to which they emphasize over-attraction to reward (strong approach motivation), under-sensitivity to punishment (weak avoidance motivation) or problems with effortful or higher-order control. In an automotive analogy, these can be thought of as a problem with a stuck accelerator, a problem of faulty brakes, or a problem of poor judgment by the driver. Many theoretical approaches to impulsivity explicitly invoke this

distinction between approach, avoidance, and higher-order cognitive systems (Carver 2005; Cloninger, 1987; Depue & Collins, 1999; Fowles, 1987; Gray, 1982; Nigg, 2001; Rothbart, Ahadi & Evans, 2000). This tripartite distinction also dovetails with proposals made by evolutionary, developmental, personality, criminological and clinical psychologists about the source of sex differences in impulsivity. In this brief overview, we describe the various theoretical orientations and formulate predictions of likely sex differences. We also note measures that have been developed to assess the constructs that are included in our meta-analysis. These are summarised in Table 16. Some theorists have been explicit in their recognition and explanation of sex differences in impulsivity. In other cases, we have inferred sex differences via theorists' proposed explanations of psychopathologies that are more prevalent in one sex than the other.

Reward sensitivity and approach motivation.

Evolutionary theory. Aggressive behaviour, as we have noted, is considerably more frequent and serious among men. Evolutionary approaches have been quite explicit in their predictions of sex differences in aggression. Across many species including our own, asymmetries of parental investment exert a significant impact on those aspects of psychology that have consequences for inclusive fitness. To the extent that effective polygyny was characteristic of hominid evolution (Archer, 2009; Larsen, 2003; Plavcan, 2001), men have had very high incentives for establishing intra-sexual dominance as a means of securing a large number of mates and increasing their reproductive success (Daly & Wilson, 1983). This competition can take the form of direct aggression, with correspondingly increased rates of homicide and decreased life expectancy, especially among men who are young and unmarried (Daly & Wilson, 1988; Wilson & Daly, 1997). Wilson and Daly (1985) suggested that the psychological mechanism underlying this male-on-male aggression is an increased 'taste for risk' among young men, a taste that also manifests itself in riskier decision-making, gambling, dangerous driving and drug use. This formulation suggests that sex differences should be most marked in those impulsivity measures that include a component of sensation seeking or risk taking. In emphasizing the appetitive nature of motivation (the positive attractions of risk), it also predicts sex differences in the sensitivity to reward associated with such risky enterprises.

Table 16: Summary of measurement categories by domain

Category	Measure(s)
	Reward Sensitivity
SPSRQ/GRAPES	Sensitivity to Reward and Sensitivity to Punishment Questionnaire (Torrubia, Avila, Molto & Caseras, 2001): Reward scale Generalized Reward and Punishment Expectancy Scales (Ball & Zuckerman, 1990): Reward scale
TPQ/TCI Reward Dependence	Tridimensional Personality Questionnaire (Cloninger, 1986): Reward scale. Temperament and Character Inventory (Center for Wellbeing, n.d.): Reward scale

BAS Total	Behavioural Activation Scale (Carver & White, 1994): Total score
BAS Drive	Behavioural Activation Scale (Carver & White, 1994): Drive scale
BAS Fun	Behavioural Activation Scale (Carver & White, 1994): Fun Seeking scale
BAS Reward	Behavioural Activation Scale (Carver & White, 1994): Reward scale
	Punishment Sensitivity
SPSRQ/GRAPES	Sensitivity to Reward and Sensitivity to Punishment Questionnaire (Torrubia, Avila, Molto & Caseras, 2001): Punishment scale Generalized Reward and Punishment Expectancy Scales (Ball & Zuckerman, 1990): Punishment scale
TPQ/TCI Harm Avoidance	Tridimensional Personality Questionnaire (Cloninger, 1986): Harm Avoidance scale Temperament and Character Inventory (Center for Wellbeing, n.d.): Harm Avoidance scale
BIS (BIS/BAS)	Behavioural Inhibition Scale (Carver & White, 1994)
	Sensation Seeking and Risk Taking
Venturesomeness	I5 (Eysenck & Eysenck, 1978), or I6/I7 (Eysenck, Pearson, Easting, & Allsopp, 1985): Venturesomeness Scale
Sensation Seeking Scale (SSS) Total	Sensation Seeking Scale Form II (Zuckerman, Kolin, Price, & Zoob, 1964), IV (Zuckerman, 1971), or V (Zuckerman, Eysenck, & Eysenck, 1978): Total score
SSS – Thrill & Adventure Seeking	Sensation Seeking Scale Form IV (Zuckerman, 1971), V (Zuckerman, Eysenck, & Eysenck, 1978), or VI (Zuckerman, 1984): Thrill and Adventure Seeking Subscale
SSS – Experience Seeking	Sensation Seeking Scale Form IV (Zuckerman, 1971) or V (Zuckerman, Eysenck, & Eysenck, 1978): Experience Seeking Subscale
SSS - Disinhibition	Sensation Seeking Scale Form IV (Zuckerman, 1971), V (Zuckerman, Eysenck, & Eysenck, 1978), or VI (Zuckerman, 1984): Disinhibition Subscale
SSS – Boredom Susceptibility	Sensation Seeking Scale Form IV (Zuckerman, 1971) or V (Zuckerman, Eysenck, & Eysenck, 1978): Boredom Susceptibility Subscale
UPPS Sensation Seeking	UPPS Impulsive Behaviour Scale (Whiteside & Lynam, 2001): Sensation Seeking scale
Dickman Functional Impulsivity	Dickman Impulsivity Inventory (Dickman, 1990): Functional

	Impulsivity scale
Risk Taking	All measures of risk taking including: The Jackson Personality Inventory (Jackson, 1994): Risk-Taking scale; Risky Impulsivity (Campbell & Muncer, 2009); and any measures developed for specific studies in the review
ZKPQ Impulsive Sensation Seeking	Zuckerman-Kuhlman Personality Questionnaire (ZKPQ; Zuckerman & Kuhlman, n.d.): Impulsive Sensation Seeking scale
KSP Monotony Avoidance	Karolinska Scales of Personality (KSP Schalling, 1978): Monotony Avoidance scale
MPQ/PRF Harm Avoidance	Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982), or Personality Research Form (PRF; Jackson, 1994): Harm Avoidance scale
Sensation Seeking (Other measures)	Any measure of sensation seeking not specified elsewhere, including: the Tridimensional Personality Questionnaire (Cloninger, 1986): Novelty Seeking scale, the Arnett Inventory of Sensation Seeking (Arnett, 1994), and any measures developed for specific studies in the review
Effortful Control: General Measures of impulsivity	
Eysenck measures of impulsiveness	I5 (Eysenck & Eysenck, 1978), or I6/I7 (Eysenck, Pearson, Easting, & Allsopp, 1985;), Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968): Impulsiveness scale
BIS Total	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Total score
KSP Impulsivity	Karolinska Scales of Personality (KSP; Schalling, 1978): Impulsivity scale
Other measures	Any measure of impulsivity not specified elsewhere, including: Personality Research Form (PRF; Jackson, 1994): Impulsivity scale, Revised NEO Personality Inventory (NEO PI-R; Costa & McCrae, 1992): Impulsivity facet, Self-discipline Deliberation scales, and any measures developed for specific studies in the review
Effortful Control: Specific forms of impulsivity	
BIS Cognitive	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Cognitive/Attentional Impulsiveness scale
BIS Motor	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton, Stanford, & Barratt, 1995)[a]: Motor Impulsiveness scale
BIS Non-planning	Barratt Impulsiveness Scale (BIS-10; Barratt, 1985; BIS -11; Patton,

	Stanford, & Barratt, 1995)[a]: Non-Planning Impulsiveness scale
UPPS Perseverance	UPPS Impulsive Behaviour Scale (Whiteside & Lynam, 2001): Lack of Perseverance scale
UPPS Premeditation	UPPS Impulsive Behaviour Scale (Whiteside & Lynam, 2001): Lack of Premeditation scale
UPPS Urgency	UPPS Impulsive Behaviour Scale (Whiteside & Lynam, 2001): Urgency scale
Dickman Dysfunctional Impulsivity	Dickman Impulsivity Inventory (Dickman, 1990): Dysfunctional Impulsivity scale
Impulse Control	Any measure of impulse control, including: the Offer Self-Image Questionnaire (Offer, Ostrov, & Howard, 1982): Impulse Control subscale, Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982) Control scale, and any measures developed for specific studies in the review
Social Problem Solving Inventory	Social Problem-Solving Inventory-Revised (SPSI-R; D'Zurilla, Nezu, & Maydeu-Olivares, 1996)[a]: Impulsive/Careless style scale
	Effortful Control: Behavioural Measures
BART	Balloon Analogue Risk-Taking Task (BART; Lejuez et al., 2002)
Delay Discounting	Any delay discounting task (see, e.g. Mazur, 1987, Richards, Zhang, Mitchell, & de Wit, 1999) using real or hypothetical rewards including money, sweets, and cigarettes.
Executive Response Inhibition	The Stop Task (Logan, Schachar, & Tannock,1997), the Go/No-Go task (Newman, Widom, & Nathan, 1985), any Stroop-based task (Stroop, 1935), the Continuous Performance Test (Conners, 2000), and the Inhibitory Reach task (Enticott, Ogloff, & Bradshaw, 2006)
Iowa Gambling Task	The Iowa Gambling Task (IGT, Bechara, 1994)
Visual-cognitive Tasks	Matching Familiar Figures Test (MFFT, Kagan, Rosman, Day, Albert, & Phillips, 1964), Intradimensional/Extradimensional learning task (IDED), Tower of London Task (ToL; Shallice, 1982), Porteus Maze (Porteus, 1950), Trail-Making Test (Reitan, 1958), Visual Comparison Task (VCT; Dickman & Meyer, 1988), and Spatial Orientation Dynamic Test-Revised (SODT-R, Colom, Contreras, Shih, & Santacreu, 2003)

[a] Includes versions translated into other languages

Sensation seeking. Zuckerman's definition of sensation seeking as "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience" highlights the compelling attraction of novel experiences—an attraction of such intensity that the individual is willing to tolerate risks in their pursuit. Zuckerman and Kuhlman (2000, p. 1001) argue that "The approach gradient is higher and the avoidance gradient (anticipated anxiety) is lower in high sensation seekers than in low sensation seekers over the range of novel risk taking activities". Sex differences have been found consistently on Zuckerman's Sensation Seeking Scale (SSS-V) (Zuckerman, 1994). These appear on the Thrill and Adventure, Boredom Susceptibility and Disinhibition subscales but are absent on the Experience Seeking subscale which measures preferences for new experiences that are not marked by risk (e.g. eating exotic food). A newer measure, the Impulsive Sensation Seeking (ImpSS) scale of the Zuckerman Kuhlman Personality Questionnaire (ZKPQ), also shows sex differences (McDaniel & Zuckerman, 2003; Zuckerman, Kuhlman, Joireman, Teta & Kraft, 1993). Sex differences in a range of risky behaviours were found to be completely mediated by the sex difference in ImpSS (Zuckerman & Kuhlman, 2000).

Zuckerman (1989, 1994, 2006) has suggested that men's role in mate competition and hunting is the distal factor driving this desire for risk. Testosterone levels are correlated with sensation seeking, as well as with prioritization of short-term goals, impulsivity, dominance, competition and sexual arousal (Archer, 2006). In terms of central nervous system action, ImpSS is proposed to result from the balance between the attraction of excitement and the avoidance of danger associated specifically with risky behaviours. The explanatory approach is biological: dopamine is involved in reward and approach behaviour, while serotonin mediates restraint. Dopamine accelerates risky behaviour because, when faced with danger, high sensation seekers experience stronger attraction than low sensation-seekers. Men's greater sensation seeking chiefly results from a more reactive dopaminergic system (Zuckerman & Kuhlman, 2000). Zuckerman also acknowledges the relevance of inhibition mediated by the serotonergic system but his chief emphasis is on the attractions of risk taking among men.

Criminology. Gottfredson and Hirschi (1990), in their General Theory of Crime, argued that the attractions of antisocial behaviour are powerful, immediate, and evident. It is criminal desistance rather than involvement that requires explanation. They proposed that criminal behaviour results from the interaction between attractive criminal opportunities and low self-control. The effect size for low self-control on crime (d = .41) in twenty-one empirical studies with 49,727 participants ranks as "one of the strongest known correlates of crime" (Pratt & Cullen, 2000, p.952).

Noting the ubiquitous sex differences in criminal behaviour, Gottfredson and Hirschi (1990, p. 147) predicted greater self-control among women resulting from the internalization of the stronger external and familial control exercised over daughters, rather than sons. Rejecting the need for sex-specific explanations of crime, they argued that self-control was equally relevant to offending by men and women, and this has been substantiated (Blackwell & Piquero, 2005; Burton, Cullen, Evans, Alarid & Dunaway, 1998; Keane, Maxim & Teevan, 1993; Piquero & Rosay, 1998; Pratt & Cullen, 2000; Tittle, Ward & Grasmick, 2003). Women have greater self-control than men (Keane et al., 1993; Nakhaie, Silverman & LaGrange, 2000; Tittle et al., 2003) and a strong hypothesis from the general theory of crime is that, when self-control is controlled, sex differences in criminal or delinquent involvement should become non-significant. This has been found in some studies (Burton

et al, 1998; Tittle et al., 2003) and, even where it has not eliminated the effect of sex, it has reduced it substantially (La Grange & Silverman, 1999; Nakhaie et al., 2000).

Low self-control has been measured as a combination of impulsivity, risk-seeking, preference for simple tasks and physical activities, temper and self-centeredness (Grasmick, Tittle, Bursik & Arneklev, 1993). However, a number of researchers have found the impulsivity and risk-seeking subscales to be almost as predictive as the full scale (Arneklev, Grasmick, Tittle & Bursik, 1993; Deschenes & Esbensen 1999; Longshore, Turner & Stein, 1996; Nakhaie et al., 2000; Piquero & Rosay, 1998; Wood, Pfefferbaum & Areneklev, 1993). Of the two traits, risk-seeking shows the stronger association with crime (Nakhaie et al, 2000; LaGrange & Silverman, 1999). It is for this reason, together with Gottfredson and Hirschi's (1990, p.89) emphasis upon the implicit attractions of crime ("money without work, sex without courtship, revenge without court delays"), that we discuss this theory as representing an approach orientation to impulsivity.

Three factor theories. Cloninger (1987) has advanced a biopsychological model of personality in the field of psychiatry. He originally postulated three genetically independent dimensions of personality: Novelty Seeking, Harm Avoidance, and Reward Dependence. The original measure of these traits was the Tridimensional Personality Questionnaire (TPQ) which was subsequently modified and renamed the Temperament and Character Inventory (TCI). Variations in the balance of these sensitivities have been used to explain a range of mental illnesses. Cloninger uses the term Novelty Seeking as an alternative to 'impulsivity,' clearly identifying its appetitive motivation (Cloninger, 1986). Novelty seeking is associated with activity in the dopaminergic reward system and is expressed as a tendency to respond to novel stimuli with excitement. The scale comprises four facets: Exploratory Excitability, Impulsiveness, Extravagance, and Disorderliness. This form of impulsivity bears a strong resemblance to sensation seeking: Not only does it correlate highly (r = .68) with the Zuckerman's ImpSS scale, but both scales correlate negatively with monoamine oxidase levels suggesting a common biological basis (Zuckerman & Cloninger, 1996). However, unlike sensation seeking, no sex difference was found for Novelty Seeking (d = -.04) in a recent meta-analysis (Miettunen, Veijola, Lauronen, Kantojarvi & Joukamaa, 2007).

Eysenck and Eysenck's (1968) early two-factor personality theory identified impulsivity as a component of Extraversion, linked to low cortical arousal and a consequent need for stimulation (resulting in sensation seeking). Impulsivity was later disaggregated into two components: Impulsiveness (poor impulse control); and Venturesomeness (stimulus hunger). The I7 inventory was developed to measure Impulsiveness and Venturesomeness as distinct traits (Eysenck, 1993).

Venturesomeness shares the original quality of stimulus hunger and hence reflects approach motivation. Eysenck aligned it with Extraversion. However, evidence suggests it is more closely associated with the Psychoticism (P) dimension of tough-mindedness, hostility and non-conformity. Men score higher than women on Venturesomeness (Eysenck, Pearson, Easting & Allsopp, 1985), and it is positively correlated with the male hormone testosterone (Aluja & Torrubia, 2004; Coccaro, Beresford, Minar, Kaskow & Geracioti, 2007; Daitzman & Zuckerman, 1980). Indeed Zuckerman (1989) suggested that the P factor really represents his dimension of impulsive sensation seeking. In support of this, the ImpSS scale loads strongly on a psychoticism factor whose best marker is Eysenck's P scale (Zuckerman et al., 1993). As with Zuckerman's sensation seeking, we anticipate Venturesomeness will show a sex difference in the male direction.

Reinforcement Sensitivity Theory. Gray (1970, 1982), a former student of Eysenck, proposed that extraversion and neuroticism should be rotated to form two new dimensions reflecting sensitivity to punishment (anxiety, associated with introversion and neuroticism) and sensitivity to reward (impulsivity, associated with extraversion and neuroticism). These new dimensions came to be called respectively the behavioural avoidance system (BIS) and the behaviour approach system (BAS).

Approach motivation is controlled by BAS which is sensitive to signals of unconditioned and conditioned reward, non-punishment, and escape from punishment. Gray labeled the personality manifestation of the BAS dimension as 'impulsivity', indicating that heightened reward sensitivity was viewed as the key source of impulsive behaviour. Note that Gray's reward sensitivity is not restricted to reward associated with sensation seeking or other risky enterprises. Activity in the BAS causes movement toward goals. Emotionally, this system generates feelings of hope, elation, and satisfaction. Dopaminergic pathways, especially between the ventral tegmental area of the midbrain and the nucleus accumbens, are implicated in its functioning. Gray made no specific predictions in this theory regarding sex differences although, like Eysenck, his formulation addressed clinical disorders where sex differences are well established. Gray's theory has been studied extensively in relation to psychopathy, a predominantly male disorder (Cale & Lilienfeld, 2002). Patterson and Newman (1993) argued that psychopaths' over-sensitivity to reward results in hyper-arousal and a consequent failure to pause and reflect when reinforcers are withdrawn. This results in dysfunctional perseveration in mixed-incentive situations.

Measures of reward sensitivity and approach motivation. Carver and White's (1994) BIS/BAS psychometric scales have been widely used to assess Gray's two dimensions of temperament. The BAS scale factors into three subscales. Reward Responsiveness (emotional enjoyment of reward), Drive (the pursuit of appetitive goals) and Fun Seeking (tendency to seek out new, potentially rewarding, experiences). Clearly this last scale overlaps considerably with aspects of sensation seeking and some work suggests that, unlike the other two BAS scales, it loads on a separate factor that has been called 'rash impulsiveness' (Dawe, Gullo & Loxton, 2004; Franken & Muris, 2006; Quilty & Oakman, 2004). Torrubia, Avila, Molto and Caseras (2001) developed another pair of scales to measure Gray's two dimensions, the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ). Sensitivity to Reward is correlated with Eysenck's I7 Impulsiveness, Zuckerman's SSS and with Excitement Seeking in the Five Factor model (Mitchell, Kimbrel, Hundt, Cobb, Nelson-Gray & Lootens, 2007). The Reward scale from the Generalized Reward and Punishment Expectancy Scales (GRAPES; Ball & Zuckerman, 1990) has also been used, and shows a positive correlation with sensation seeking. A recent meta-analysis found that women scored higher than men (d = -.63: Miettunen et al., 2007) on the Reward Dependency scale of the Cloninger's TCI.

The two most widely used measures of sensation seeking and risk taking are Eysenck's I7 Venturesomeness scale and Zuckerman's Sensation Seeking Scale. The Monotony Avoidance scale of the Karolinska Scales of Personality also captures the intolerance of boredom that corresponds to the SSS-Boredom Susceptibility subscale. The more recent Zuckerman Kuhlman Personality Questionnaire (ZKPQ) contains a scale of Impulsive Sensation Seeking (ImpSS). Dickman (1990) distinguished between Dysfunctional Impulsivity (a tendency to act with less foresight than most others leading the individual into difficult situations) and Functional Impulsivity (a tendency to respond quickly when the situation is optimal, such as taking

advantages of unexpected opportunities). These form separate scales on the Dickman Impulsivity Inventory (DII). Those who score high on Functional Impuslivity are characterized as "enthusiastic, active individuals who are willing to take risks" (Dickman, 1990, p.98). This suggests, and data confirm, that Functional Impulsivity is closely aligned with sensation seeking, The UPPS Sensation Seeking scale resulted from Whiteside and Lynam's factor analysis of 21 impulsivity scales. Tellegen's (1982) Multidimensional Personality Questionnaire (MPQ) contains a subscale of Harm Avoidance the items and structure of which correspond to reversed sensation seeking and we analyze it together with other sensation seeking measures (See Table 16).

Punishment insensitivity and avoidance motivation.

Here we consider approaches to impulsivity that highlight a hyposensitivity to the negative consequences of impulsive acts. These are distinguished from approaches which view impulsivity as a failure of effortful control (which we discuss later) by virtue of the fact that they deal with deficits in reactive or motivational, rather than cognitive, control.

Evolutionary theory. Campbell (1999, 2002) proposed an evolutionary account, complementary to that of Daly and Wilson (1988), which focuses on female disincentives for risk. Women's reproductive success depends upon avoiding injury and death to a greater extent than men's. This results from infants' greater dependence on the mother than on the father, women's higher parental investment in each offspring, and the limited number of offspring that a woman can bear in a lifetime. Hence women should be more sensitive to and more avoidant of danger than men, an effect which is mediated by higher levels of fear about physical injury or death. Cross-culturally, fear is experienced more intensely and frequently by women than by men (Brebner, 2003; Fischer & Manstead, 2000). As with Daly and Wilson's formulation, the prediction is that sex differences will be manifest in those impulsivity inventories that contain an element of risk. But because Campbell's proposed mediating variable is fear, women should show greater harm avoidance than men, and possibly greater sensitivity to punishment reflected in higher BIS scores.

Three factor theories. In Cloninger's tripartite theory, harm avoidance is mediated by activity in a serotonergic punishment system and is manifest in a tendency to respond strongly to signals of aversive stimuli by inhibiting ongoing behaviour. High scorers are "cautious, tense, apprehensive, fearful, inhibited, shy, easily fatigable, and apprehensive worriers" (Cloninger, 1987, p. 576). A recent meta-analysis (Miettunen et al., 2007) reported a small-to-moderate effect size favoring women on Harm Avoidance (d = -.33).

When Eysenck disaggregated impulsivity, he aligned Impulsiveness with Psychoticism, a dimension characterized by poor impulse control. It was associated with insensitivity to punishment, and a tendency to respond quickly and without regard to interpersonal consequences (Eysenck & Gudjonsson, 1989). However testosterone does not show the expected association with Impulsiveness (Aluja & Torrubia, 2004; Coccaro et al., 2007; Daitzman & Zuckerman, 1980) and norms for impulsiveness show no sex differences (Eysenck et al., 1985).

Reinforcement sensitivity theory. Gray's (1970) theory proposed that behaviour was governed by the balance between three motivational systems. He identified the BAS system, described earlier, as the basis for impulsivity. The behavioural avoidance system (BIS) is an aversive motivational system which is sensitive to signals of punishment, non-reward and novelty. Activity in the BIS inhibits behaviour. Emotionally, the system

is associated with feelings of fear, anxiety, and frustration. BIS has been localized to the right anterior cortex. Gray also argued for a third flight/fight system (FFS) sensitive to innately aversive stimuli and associated with Eysenck's third dimension of Psychoticism.

In a subsequent revision of the theory (Gray & McNoughton, 2000), the FFS, associated with fear, became responsible for avoidance as well as escape behaviours. The BIS, associated with anxiety, became responsible for resolving motivational conflicts e.g. between approach and avoidance. The BAS remained relatively unaltered. However these revisions, including the distinction between fear- and anxiety-related avoidance processes and the new role of the BIS, have not been reflected in personality inventories used to assess punishment sensitivity (but see Heym, Ferguson & Lawrence, 2008; Perkins & Corr, 2006). Most researchers continue to work with Gray's original formulation (Bijttebier, Beck, Claes & Vandereycken, 2009; Smillie, 2008).

As noted, Gray's work has been applied to psychopathy. Although Gray proposed that overactive BAS was the source of impulsivity, Lykken (1957) suggested that psychopaths' lack of fear resulted in a failure to form classically conditioned associations between fear and rule breaking. Thus psychopaths lack the normal negative reinforcer (fear reduction) required for active and passive avoidance learning. Fowles (1988) suggested that psychopaths have a weak behavioural inhibition system (BIS) and hence perform particularly poorly where passive avoidance (inhibition of a response) is required. A distinction has been made between primary and secondary psychopathy that may unite these different positions. Primary psychopaths, who correspond to the popular stereotype of the disorder, experience low levels of anxiety (weak BIS) which give rise to their antisocial actions (Lykken, 1995). Secondary psychopaths experience heightened negative emotions and are hyper-responsive to opportunities for reward reflected in stronger BAS (but normal BIS) reactivity. This proposal has recently received empirical support (Newman, MacCoon, Vaughn & Sadeh, 2005; Ross, Molto, Poy, Segarra, Pastor & Montanes, 2007; Wallace, Malterer & Newman, 2009).

In sharp contrast to psychopathy, anxiety disorders are found more often in women than in men (Frank, 2000), and anxiety was the original focus of Gray's (1982) BIS punishment hypersensitivity formulation. A considerable body of work has established that anxiety is associated with preferential attention to threatening stimuli. Orienting responses occur before the nature or meaning of the stimuli is consciously registered, and this indicates the engagement of low-level reactive processes which are automatic, unintentional, and unconscious (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van Ijzendoorn, 2007). This attentional bias has been shown both in patients suffering from a range of anxiety disorders (Barlow, 2002) and in non-clinical samples high in trait anxiety (Mogg, Bradley, Dixon, Fisher, Twelftree & McWilliams, 2000). Among people suffering from depression, women and girls more frequently ruminate about negative life events, which both exacerbates depressive symptoms and indicates an attentional preoccupation with punishment (Rood, Roelofs, Bogels, Nolen-Hoeksema & Schouten, 2009). Given women's higher levels of sub-clinical anxiety and depression (Costa, Terracciano & McCrae, 2001), we expect women to be particularly sensitive to cues of punishment.

Measures of punishment sensitivity. Carver and White's (1994) BIS/BAS psychometric scales include a single BIS scale which measures sensitivity to signals of punishment. This scale correlates with measures of negative affectivity, negative temperament, and anxiety. Torrubia et al.'s (2001) SPSRQ Sensitivity to Punishment scale is correlated with Carver and White's BIS and with harm avoidance and anxiety (see also

Caseras, Avila & Torrubia, 2003). Punishment sensitivity as measured by GRAPES correlates significantly with the BIS scale and anxiety (Gomez & Gomez, 2005). The TPQ/TCI measure of Harm Avoidance assesses an individual's tendency to respond intensively to signals of aversive stimuli by inhibiting or stopping behaviour (Cloninger, 1987). We included it as a measure of punishment sensitivity. Note that the identically named scale from the MPQ measures reversed sensation seeking (See Table 16).

Effortful control.

Effortful control describes the "ability to choose a course of action under conditions of conflict, to plan for the future, and to detect errors" (Rothbart 2007, p.207). Behaviourally, it is defined as the ability to inhibit a dominant response and perform a subdominant response. It is a major form of self regulation manifested as conscious or effortful decision-making in the service of longer-term objectives. It is the planfulness and executive nature of this ability that distinguishes it from the reactive or motivational theories that we have previously described.

Evolutionary. MacDonald (2008) argued that although evolution has shaped dedicated psychological modules (adaptations) to solve recurrent evolutionary problems, the effortful control system can inhibit such 'automatic' evolved responses and thereby reduce impulsivity. MacDonald argued for sex differences in impulsivity based on strong sexual selection for male intrasexual competition which makes it less amenable to override by effortful control: "Males are thus expected to be higher on behavioural approach systems (sensation seeking, impulsivity, reward seeking, aggression) and therefore on average be less prone to control prepotent approach responses" (MacDonald, 2008, p. 1018). This sex difference should be particularly marked during adolescence and young adulthood when reproductive and competitive drives are strongest. In addition, future discounting (a preference for immediate rather than delayed reward) may be adaptive for individuals growing up in highly stressful environments and may underlie the sex difference in risk taking (Kruger & Nesse, 2006; Wilson & Daly, 1997).

Bjorklund and Kipp's (1996) proposal of evolved sex differences in impulsivity was not restricted to the domains of aggression and risk taking. They argued that inhibitory ability was especially critical to women's reproductive success in relation to mate choice and offspring care. Because women contribute the lion's share of parental investment, selectivity in mate choice is more important to women. This makes the ability to conceal sexual interest advantageous in the service of evaluating long-term mate prospects. Women can gain additional genetic and material resources from clandestine copulations and here again inhibitory control over the 'leaked' expression of sexual interest in other men would be beneficial in securing the commitment of a long-term partner. In addition, the protracted dependency of offspring places strain on a mother's self-control. She must prioritize the infant's needs over her own, inhibit aggressive impulses toward it and delay her own gratification–– all of which would be aided by improved inhibitory control. Bjorklund and Kipp proposed that women's advantage in inhibition would be relatively domain-specific, and evident only in those tasks that assayed social and emotional restraint. Their narrative review supported this hypothesis, concluding that women's superiority over men was evident in the social domain (e.g. facial and bodily concealment of feelings), present though less strong in the behavioural domain (e.g. resistance to temptation), and absent in cognitive inhibition (e.g. Stroop

test, memory interference, selective attention). This proposal predicts a female advantage in inhibitory control specifically in interpersonal domains.

Developmental. Rothbart and co-workers explored the concept of effortful control as a form of self-regulation from a developmental perspective (Rothbart & Bates, 2006; Rothbart & Derryberry, 1981; Rothbart & Posner, 2006). Their model includes lower-level motivational approaches but is distinguished by its emphasis on the child's acquisition of higher-level cognitive control of impulsivity. In the early months, infants are primarily reactive to events and the two dimensions that capture variation in their temperamental responses map onto Gray's BIS and BAS systems (Rothbart, 2007; Rothbart et al., 2000). These have been measured by scales assessing Negative Affectivity and Extraversion/Surgency, corresponding to BIS and BAS respectively. Together these two systems modulate avoidance and approach behaviour. With increasing age the child develops effortful control, a form of self-regulatory executive control in the affective domain (MacDonald, 2008). This system is superordinate to the more primitive motivational systems and it allows the individual to suppress reactive tendencies in the service of longer-term objectives. Attention shifting and behavioural inhibition allow the child to suppress prepotent but inappropriate behaviour. The likely site of these processes is the ventromedial prefrontal cortex, particularly the orbitofrontal cortex and the ventral anterior cingulated cortex (MacDonald, 2008; Posner & Rothbart, 2009).

Lower- and higher-level systems are not wholly independent because "the motivational circuits can function as specialized learning mechanisms, guiding the development of cortical representations in light of underlying appetitive and defensive needs" (Derryberry & Rothbart, 1997, p.639). Cross-lagged correlations have been reported between early fear and later effortful control (e.g. Kochanska & Knaack, 2003). This association is attributed to the greater amenability of more fearful children to parental socialization practices (Derryberry & Rothbart, 1997). Girls are more fearful than boys (Else-Quest, Hyde, Goldsmith & Van Hulle, 2006; Hsu, Soong, Stigler, Hong, & Liang, 1981; Maziade, Boudreault, Thivierge, Caperaa & Cote, 1984) and this suggests that girls may exceed boys in effortful control. Else-Quest et al.'s (2006) meta-analysis of childhood temperament differences revealed a large effect size favoring girls for effortful control, d = -1.01. However, this dimension is a composite of scales from the Child Behaviour Questionnaire reflecting an easy-going, low-demand temperament which is apparently more characteristic of girls than boys. Impulsivity is measured separately as a subscale of the Extroversion / Surgency dimension (broadly corresponding to BAS or approach motivation) and this showed a smaller effect size in the male direction (d = .18).

The development of the prefrontal cortex that mediates effortful control continues through adolescence and into adulthood (Casey, Getz & Galvan, 2008; Sternberg, 2007). Although impulsive behaviour in childhood may result from the balance between the two lower-level reactive systems, in adulthood it is likely to be associated with weak or ineffective effortful control (Posner & Rothbart, 2009). Baumeister and colleagues (Baumeister, Vohs & Tice, 2007; Muraven & Baumeister, 2000) use the term 'self-control' to refer to control over thoughts, emotions, performance and impulses. Self-control bears a strong similarity to effortful control and indeed Baumeister et al. (2007; p.351) describe it as a "deliberate, conscious, effortful subset of self-regulation". It is assessed as an amalgam of self-discipline, deliberate/non-impulsive action, reliability, healthy habits, and work ethic (Tangney, Baumeister & Boone, 2004). Although sex differences have not been the focus

of research, R. Baumeister (personal communication, February 18, 2010) has suggested a likely female advantage in self-control as a result of men's stronger impulses, especially in the domains of sex and aggression.

Measuring effortful control: Behavioural tasks. Effortful control has been studied using laboratory tasks (see Table 17 for a summary of tasks included in the present analysis). The range of tasks has been wide and the specific processes on which they depend underspecified. In some cases, the conceptual link to impulsivity seems tenuous. Post hoc attempts to classify them empirically have not produced consistent findings, probably as a result of the different tasks selected for inclusion in the analyses (e.g. Kindlon, Mezzacappa, & Earls, 1995; Lane, Cherek, Rhodes, Pietras & Tcheremissine, 2003; Meda et al., 2009; Reynolds, Ortengren, Richards & de Wit, 2006; Reynolds, Penfold & Patak, 2008). It is generally agreed that effortful control has two important characteristics: it involves the conscious suppression of a prepotent or dominant response, and it permits individuals to take a longer time perspective with regard to their actions. The distinction between these forms of control has been supported in factor analytic studies of behavioural tasks (Lane et al., 2003; Reynolds et al., 2008; Reynolds, Ortengren et al., 2006) and by neuroimaging studies which implicate different neural pathways for the two processes (Band & van Boxtel, 1999; McClure, Laibson, Loewenstein, & Cohen, 2004).

Table 17: Summary of behavioural tasks of impulsivity

Executive response inhibition tasks	
Go/No-go	Two randomly alternating stimuli are presented (e.g. a car and a house). The respondent is instructed to respond selectively to one but not the other by pressing a button. One stimuli is presented more frequently to establish a prepotent response. Commission errors index impulsivity.
Stop signal	Similar to the Go/No-Go task but on some trials a signal (usually auditory) is given immediately after the critical target stimulus. On these trials, the respondent must inhibit their response.
Continuous performance task	Letters appear one at a time on a screen. The respondent must press a button when a particular sequential configuration (e.g. C followed by A) is shown. Commission errors index impulsivity.
Stroop	In the control condition, the respondent names aloud the ink colour of a row of XXXX as quickly as possible. In the interference condition which follows the respondent must name aloud the ink colour in which a series of words is written: Each word is a colour name (e.g. red) that is different from the ink colour (e.g. blue) used to print it. The two conditions are compared and the disparity between them is an index of interference suppression. A smaller value (less disparity) indexes impulsivity. Some researchers use errors or time on the interference condition.

Visual cognitive tasks	
Matching familiar figures task (MFFT)	A target design is presented together with a number of similar designs. The task is to match the target with its identical version. Speed and errors reflect impulsivity.
Visual comparison task	Similar to MFFT but the respondent is presented with two very similar figures and makes a 'same' or 'different' decision.
Trailmaking	The respondent draws lines joining 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the respondent connects the numbers in ascending order. In Part B, the circles include both numbers (1 – 13) and letters (A – L). The respondent is asked to alternate between numbers and letters (i.e., 1-A-2-B-3-C, etc.). The respondent is instructed to work quickly and not to lift the pen from the paper. Errors are pointed out to the respondent and correction is allowed. Errors affect the score by increasing the time taken to complete the task. The time taken for Part A is subtracted from the time taken for Part B. A smaller value reflects impulsivity.
Porteus maze	This is a graded set of paper forms on which the respondent traces the way from a starting point to an exit, avoiding blind alleys. There are no time limits. The mazes vary in complexity from simple diamond shape to intricate labyrinths. The Q score, used to index impulsivity, is obtained by measuring the number of times the pencil is lifted, touches the boundary etc.
Circle tracing	Respondents are asked to trace over a 9 inch circle as slowly as they can. The start and stop position are clearly marked on the circle in bright letters. Impulsivity is indexed by time taken to perform the task on the second trial.
Spatial orientation dynamic task (R)	A computerised task in which participants move a red and a blue dot toward a specific destination. The program sets a course for the two dots that can be modified by pressing arrow buttons for each of the dots. The dependent measure is the mean deviation (in degrees) between the course of each of the moving dots at the end of the trial and the course it should have taken to reach its destination. Impulsivity is indexed as a high mean deviation.
Tower of London	A board presents coloured discs or beads arranged on three vertical pegs. These form a target array which the participant must try to replicate when their own board where the discs or beads are arrayed differently across the three pegs. Measures include preplanning time (time between seeing the discs and making the first move), errors on the first move, average move time (time spent on executing the plan), trials solved in the minimum number of possible moves or within a specified time limit, and excess moves (number of moves in excess of the minimum necessary to complete the task).
Intradimensional extradimensional shift	Two dimensions (colour filled shapes and white lines) are used. Simple stimuli use only one of these dimensions, whereas compound stimuli are made up of both (e.g. white lines overlaying colour-filled shapes). The subject starts by seeing two simple colour-

	filled shapes, and must learn which one is correct by touching it. Through feedback, the respondent learns which stimulus is correct. After six correct responses, the stimuli and/or rules are changed. These shifts are initially intra-dimensional (e.g. colour-filled shapes remain the only relevant dimension), then extra-dimensional (white lines become the only relevant dimension). The test has a number of outcome measures (including errors, and numbers of trials and stages completed) which index impulsivity.
Delay discounting	
The participant makes a series of dichotomous choices between a 'standard' (e.g. $10 available after one of six delays: 0, 7, 30, 90, 180, 365 days) and an 'alternative' sum of money available immediately (e.g. 23 values between $0.01 and $10.50), resulting in 137 choices. The choices are presented in random order. The *indifference point* or *switch point* (the point at which the participant prefers the immediate to the delayed reward) is determined for each level of the standards. This can be used to calculate k the rate at which the standard of $10 is discounted as a function of delay. Impulsive individuals show lower switch points and a higher value of k (a steeper rate of discounting) than less impulsive individuals. Variations on this task include probability discounting task (which uses probabilistic rather than delayed rewards) and the experiential delay task (in which participants choose between a probabilistic delayed sum and a smaller sum that is immediate and certain).	
The Iowa Gambling Task	
The participant is shown four decks of cards. Each card informs them of a win, or a simultaneous win and loss of money. Two 'disadvantageous' card decks (A and B) yield high monetary rewards but higher occasional losses. Two 'advantageous' decks (C and D) yield low rewards but lower occasional penalties. Impulsive individuals continue to choose from the disadvantageous decks despite the long-term loss to which this strategy leads. The outcome measure is normally the number of draws from disadvantageous packs (A and B) subtracted from advantageous packs (C and D). This is taken as a measure of impulsivity manifest in a preference for short–term gains in spite of long-term losses.	
The Balloon Analogue Risk Task (BART)	
A computer screen shows a balloon and pump. Each click on the pump inflates the balloon and, with each pump, 5 cents are earned in an invisible temporary reserve. Participants are told that at some point each balloon will explode. When a balloon is pumped past its explosion point, an audible "pop" signals that all the money in the temporary reserve is lost. At any point during a trial, the participant can stop pumping the balloon and transfer the money in the reserve to the permanent bank. After each balloon explosion or money transfer, a new balloon appears. The dependent measure is normally the average number of pumps excluding balloons that exploded (i.e., the average number of pumps on each balloon prior to money collection). This reflects a tendency to continue with balloon inflation despite the risk of losing the money already won on that trial.	

Four tasks have been widely interpreted as assessing the ability to suppress a dominant or prepotent response, which we will refer to as *executive response inhibition* (Conners, 2000; Kindlon et al., 1995; Lane et al., 2003; Reynolds et al., 2008; Reynolds, Richards, & de Wit, 2006; Nigg, 2001). These are the Go/No-Go task, the Stop Signal task, the Stroop test, and the Continuous Performance task. These tasks may also be sensitive to failure of interference protection and to inattention (Dougherty et al., 2009; Reynolds et al., 2008).

A second quality of effortful control is the ability to select actions by taking into account their long-term rather than immediate consequences. Individual differences in time horizons have been assessed chiefly by behavioural tasks where a choice must be made between a larger long-term and a smaller short-term reward (Lane et al., 2003; Reynolds et al., 2008). The most popular measures are the *Delay Discounting Task* and its variants. More impulsive individuals are believed to show a steeper rate of discounting. The *Iowa Gambling Task* (IGT) has also been interpreted as assessing time perspectives with regard to reward (Bechara, Damasio, Tranel & Damasio, 1997). More impulsive individuals persist in their attraction to short-term higher rewards despite the long-term loss to which this strategy leads. The *Balloon Analogue Risk Task* (BART) assesses a participant's willingness to risk loss in the service of winning a higher monetary reward (Lejuez et al., 2002) and has been found to load on a common factor with delay discounting (Reynolds, Ortengren, et al., 2006; but see Meda et al., 2009). These three tasks are distinguished from lower-level 'automatic' responses to reward or punishment on the basis that the tasks require a conscious and deliberate decision.

Other tasks used to assess impulsivity do not clearly align themselves with the distinction between behavioural disinhibition and time horizons. We refer to these as *visual-cognitive tasks* because they are united by their use of visual attention paradigms to explore various aspects of executive function including planning, set formation and switching, and motor control. Most infer impulsivity from the number of errors made on the task, based the assumption that impulsive individuals tend to trade speed for accuracy, although this proposal has been controversial (Block, Block & Harrington, 1974; Dickman & Meyer, 1988; Malle & Neubauer, 1991; Quiroga et al., 2007; Wilding, Pankhania & Williams, 2007).

Measuring effortful control: Psychometric measures. The two cardinal aspects of impulsivity, failure to inhibit a prepotent response (e.g. "I say things without thinking") and short time horizons (e.g. "I plan trips well ahead of time") also appear as items in psychometric inventories. However, the two components are not always distinguished as separate scales. The two most commonly used inventories of general impulsivity are the Eysenck's Impulsiveness questionnaires (I5, I6, I7 and the EPI) and the total score from the Barratt Impulsiveness scale. We also consider the Impulsivity scale of the Karolinska Scales of Personality as a general measure of impulsivity.

In addition to these global measures, there is an arsenal of measures for assessing subtypes of impulsivity. Many of these have been derived from factor analyses of novel or extant items and scales. Because the factor solution depends on the selection of scales included, there is little consensus on the fundamental dimensions of impulsivity. We now briefly describe some of the major conceptual distinctions which we include as measures of specific impulsivity.

The Barratt Impulsiveness Scale (most recent version BIS-11, see Patton et al., 1995; Stanford et al., 2009) distinguishes between; Attentional/Cognitive Impulsiveness (easily distracted and has difficulty in controlling thoughts); Motor Impulsiveness (acts without thinking and lacks perseverance); and Non-planning

Impulsiveness (fails to make plans and is bored by cognitive complexity). The latter two scales correspond broadly to response disinhibition and short time horizon. A recent psychometric evaluation indicated no sex differences on any of the scales (Stanford et al., 2009).

Whiteside and Lynam (2001) included many existing impulsivity scales (as well as the Big Five personality traits) in a factor analysis from which they derived their four UPPS measures. Lack of Premeditation (a failure to delay action in order to think or plan) elides the components of response disinhibition and time horizons. Lack of Perseverance captures poor self-discipline resulting in an inability to resist boredom and remain with a task until completion. Urgency is the tendency to act rashly when experiencing strong negative affect. (Their fourth subscale, Sensation Seeking, is considered separately under sensation seeking measures.)

Dickman's (1990) Dysfunctional Impulsivity scale reflects failure of deliberation and response inhibition, and we consider it as a subtype of impulsivity. We treat the Functional Impulsivity scale as a measure of sensation seeking, as discussed earlier.

Other measures of impulsivity are factors or scales taken from global personality inventories. Tellegen's (1982) Multidimensional Personality Questionnaire (MPQ) contains a facet scale of Control vs. Impulsiveness. We include this facet in preference to the higher-order factor of Constraint which aggregates Control vs. Impulsiveness with Harm Avoidance and Traditionalism. We also include the Impulsivity/Carelessness scale from the Social Problem Solving Inventory (D'Zurilla, Nezu & Maydeu-Olivares, 1996).

In the NEO-PI-R, Costa and McCrae (1992) identified three forms of impulsivity. They employed the term Impulsiveness narrowly for a facet of Neuroticism defined as the 'inability to control cravings and urges" (suggesting commonality with Whiteside and Lynam's Urgency scale). Women score significantly higher with effect sizes of d = -.23 in the US and d = -.11 in other cultures (Costa et al. 2001). The authors explicitly note this facet "should not be confused with spontaneity, risk taking or rapid decision time". This latter quality, which corresponds more closely with other researchers' definitions, appears to be measured by Deliberation ("the tendency to think carefully before acting") and perhaps by Self-Discipline ("the ability to begin tasks and carry them through to completion despite boredom and other distractions"). Both of these are facets of Conscientiousness and sex differences are non- significant on both scales (Costa et al., 2001).

Despite these distinctions between subtypes, there is considerable similarity between items that belong to different scales and load on different factors. Consider for example two items: 'I am a steady thinker' and 'I am a careful thinker'. Both are from the BIS-11 but the first assesses Attentional Impulsiveness and the second Motor Impulsiveness. The following three items again seem to have similar meanings but come from different scales and inventories : 'I have trouble controlling my impulses' (UPPS Urgency); 'I act on impulse' (BIS Motor Impulsiveness) and 'I often make up my mind without taking the time to consider the situation from all angles' (Dickman Dysfunctional Impulsivity). The various scales include a mixture of items reflecting poor inhibition of behaviour, over-fast decision-making, restlessness, inattention, low anxiety and failure of long-term planning. Many rely on general statements such as "I am an impulsive person" where the respondent must effectively employ their own understanding of impulsivity to formulate an answer.

In studies where psychometric and behavioural measures are both employed, weak or non-significant correlation between them are typically reported (Crean, de Wit & Richards, 2000; Gerbing, Ahadi, & Patton,

1987; Helmers, Young & Pihl, 1995; Lane et al., 2003; Malle & Neubauer, 1991; Milich & Kramer, 1984; Paulsen & Johnson, 1980; Mitchell, 1999; Reynolds et al., 2008; Reynolds, Ortengren, et al., 2006; Reynolds, Richards, et al., 2006; White et al. 1994). Those significant correlations that do emerge do not appear to be differentially identified with behavioural and trait measures where congruence might be expected (Kirby, Petry & Bickel, 1999; Mobini, Grant, Kass & Yeomans, 2007; Swann, Bjork, Moeller & Dougherty, 2002).

Hypotheses and overview of the study

As the preceding discussion indicates, there is a wide range of measures designed to assess impulsivity based on disparate theoretical approaches and operationalisations. Any researcher wishing to use impulsivity as an explanatory variable might use any one of these, depending on his or her definition of impulsivity and reason for wanting to measure it. Part of the aim of the present analysis was to demonstrate the variety of ways that psychologists measure impulsivity and to examine the extent to which significant sex differences depend upon the choice of theoretical approach and measure.

Men are expected to score higher on measures of sensation seeking and novelty seeking. At an evolutionary level, this expectation derives from men's lower parental investment and the consequent reproductive benefits associated with risk taking in the service of mate competition and hunting. This male advantage, to the extent that it derives from an evolved module, is likely to occur at a motivational level and to be resistant to conscious or strategic control (MacDonald, 2008). Most theorists attribute men's greater sensation seeking to a strong appetitive motivation and thus predict that men should demonstrate higher BAS or sensitivity to reward than women. However, Campbell argues from an evolutionary perspective that women's aversion to sensation seeking results from their lower threshold for experiencing fear. Similarly Cloninger, from a proximal genetic and neurochemical basis, argues for greater Harm Avoidance by women. Women's higher levels of anxiety and depression suggest a greater sensitivity to threatening stimuli. We expect this to be reflected in a higher BIS and sensitivity to punishment scores among women.

When we move from risk-seeking to more global aspects of impulsivity, sex differences are likely to depend on the inventory or task used (Costa et al., 2001; Feingold, 1994; McCrae et al., 2005). Different inventories and tasks appear to assess very different components of impulsivity ranging from inability to resist food when feeling depressed to errors in spatial navigation. Even within the same task or inventory, very different aspects of impulsivity are included. On psychometric inventories, the general wording of some question (e.g. "I act on impulse") may result in men and women tending to spontaneously think of different sex-typical contexts. This would tend to diminish the power to detect consistent sex differences. Nonetheless developmental studies have shown a large effect size favoring girls for effortful control (Else-Quest et al., 2006) and, in their narrative review, Bjorklund and Kipp (1996) claimed a female advantage in social and behavioural tasks in line with their evolutionary hypothesis. Several researchers have proposed that the greater strength of male drives makes them harder to hold in check (MacDonald, 2008; Zuckerman, 1994). We tentatively predict that women will demonstrate greater effortful control than men.

In addition to examining sex differences in central tendency, we also compute male: female variance ratios for different measures of impulsivity. A male-biased variance ratio has been found for a number of physical and psychological traits (Hedges & Nowell, 1995; Lehre, Lehre, Laake & Danbolt, 2009). From an

evolutionary perspective, Archer and Mehdikhani (2003) proposed that men are freer than women to vary in their levels of parental investment giving rise to greater male variability on sexually selected traits. Their analysis bore this out for measures of physical aggression and mate choice. The present data afford the opportunity to extend this proposal of greater male variance, as well as a higher male mean, to impulsivity — a trait that has also been argued to be sexually selected (Daly & Wilson, 1988).

The analysis begins by computing pooled mean effect sizes for measures of impulsivity. We then aggregate the measures in order to estimate higher order d values, grouping them conceptually in terms of: (1) Reward Sensitivity, (2) Punishment Sensitivity, (3) Sensation Seeking and Risk Taking, (4) General Impulsivity (5) Specific Forms of Impulsivity, and (6) Behavioural Measures of impulsivity. For both psychometric and behavioural measures, the homogeneity of the effect sizes is computed and, where there is significant heterogeneity, moderator analyses are conducted to determine the explanatory utility of variables such as source, age and nationality of the sample in accounting for variation in effect sizes. Mean variance ratios are also presented in relation to possible sex differences in variability.

Method

Sample of studies

The initial search was conducted using the database PsycINFO which has a broad coverage of psychology and social science journals as well as unpublished dissertations. Search terms included the key words 'impulsivity' and 'impulsiveness' but not 'sex' or 'gender' in order to prevent selection bias. Specific inventories were not searched for because the aim was to identify the range of measures used for assessing impulsivity. This was especially important due to historic variations in the conceptualization and operationalizaton of this concept. The following search limits were imposed: (1) Human populations only, (2) English language only, (3) Male and female populations, (4) Age groups above the age of 10, and (5) Articles published between 1980 and 2008. The search yielded 3,156 abstracts.

Abstracts were screened and any articles failing to meet the following criteria were removed: (1) The study was empirical. (2) The sample included a minimum of 10 males and 10 females. (3) Data from normative samples were reported (defined as samples with no specified a priori selection factors regarding traits or behaviours). For example, samples of alcoholics or children of alcoholics were excluded whilst studies of the drinking habits of normative student populations were included. Where clinical studies were examined, data were only recorded from normative control groups. (4) Self-reported, psychometric and/or behavioural measures were used. (5) Impulsivity was measured as an independent construct. For instance, some common ADHD checklists amalgamate hyperactivity and impulsivity into a single dimension and report a single combined measure. Such scales were excluded. (6) Data were presented or potentially available from which a sex difference could be calculated. Where abstracts did not provide sufficient information to establish whether they met the inclusion criteria, they were included in the next stage of the selection process.

One thousand and sixty five articles were downloaded or requested through interlibrary loan and 70 unpublished dissertations were downloaded via the ProQuest database. If an article met the inclusion criteria but lacked sufficient data for an effect size to be computed, authors were contacted by email if the article had been

published within the last 5 years. Two hundred and three such requests were made with 75 usable responses. In twelve cases, authors provided additional data from studies not identified in the initial search.

Two hundred and forty four articles and 33 unpublished studies were included in the meta-analysis, giving a total of 277 studies with 310 samples. From these, 741 d values were calculated (See Appendix 2 in conjunction with the references for a listing of all studies included in the analysis).

Coding the studies.

For each study, the following information was coded: (1) All statistics relevant to the magnitude of the sex difference (means, standard deviations, correlations, t and F tests), (2) The number of male and female participants, (3) The measure(s) of impulsivity employed in the study, (4) The population studied (university, community, schools or colleges), (5) The age of the sample (mean, standard deviation, or range), (6) The nationality of the sample, (7) The publication status of the study, and (8) The sex of the first author. The coding of categorical variables was undertaken by two coders. Cohen's kappa was calculated as a measure of interrater agreement and ranged from .83 (age) to 1.00 (publication status). Discrepancies were checked and resolved by agreement between the two coders. Across all measures, 741 effect sizes were analyzed with a total sample size of 149,496 participants from 27 different countries (see Table 18).

Table 18: Summary statistics for all samples included in the analysis

Category	k	Male N	Female N
Age			
11-15	34	13215	14032
15-18	42	21395	22333
18-21	84	12492	18856
21-30	76	8964	11516
30-40	29	5239	7489
40 +	19	3605	4050
Age not specified/wide age range	26	2911	3400
Geographical area			
US, Canada, & Central America	184	41467	46807
UK, Europe, Australia & New Zealand	115	23525	31838
Asia, Africa, & Middle East	11	2830	3030
Population			
Schools (up to age 18)	51	29264	30019
University/College students	147	17203	27107
Community	89	16073	18388
Mixed/not specified	23	5282	6162
Publication status			
Published	275	61220	74898
Unpublished	35	6601	6777
Domain			

Category	k	Male N	Female N
General measures of impulsivity	206	50805	62428
Specific measures of impulsivity	62	7873	10891
Sensation seeking and risk taking	130	23402	28914
Reward sensitivity	18	2380	3598
Punishment sensitivity	19	2698	4212
Behavioural measures	50	3746	3753
Grand total	310	67821	81675

Note: k = number of samples

Grouping by category.

Effect sizes were grouped into forty measurement categories (see Table 16). Of these, thirty five represented established measures. Some studies, however, used measures created specifically for their study, unpublished measures, or measures that did not appear more than twice in the whole sample of studies. These were placed into one of five general categories: General Impulsivity Other Measures, Sensation Seeking Other Measures, Risk Taking, Impulse Control, and Visual-Cognitive tasks.

Grouping by Domain.

As indicated in the Introduction, considerable variability in the conceptualizations of impulsivity exists. To address this, and to assist in interpretation, measures were also grouped into six domains of impulsivity (see Table 16). Given the lack of consensus about the dimensionality and conceptualization of impulsivity, some researchers may disagree with these groupings. Results are therefore presented to allow examination on both a category-by-category basis and by domain. What follows is a summary of each domain.

Reward and Punishment Sensitivity were included as two distinct domains to address the suggestions that impulsivity might be explained by oversensitivity to reward or by deficiencies in sensitivity to punishment. *Sensation Seeking and Risk Taking* measures are distinguishable from impulsivity measures by their greater emphasis on risk, sensation and danger than on the impulsiveness of the action, as discussed in the Introduction. Such inventories clearly identified themselves as concerned with sensation seeking or subtypes thereof. The Harm Avoidance scale of the Multidimensional Personality Questionnaire (MPQ) was also included in this domain: this scale defines a high scorer as not enjoying the excitement of adventure and preferring safer activities even if they are tedious (Tellegen, 1982). *General Impulsivity* included inventories which posed questions at a general level (e.g. "I am an impulsive person") rather than specifying contexts or distinguishing psychological functions. Impulsivity is often assessed here as a global construct as opposed to subtypes (e.g. motor impulsiveness). Studies reporting total scores derived from summing or averaging specific subscales are analyzed here. *Specific Forms* of impulsivity assess impulsivity in specific psychological processes or contexts. Specific measures stem from factor analytic studies indicating that impulsivity is multidimensional. Note that UPPS Sensation Seeking and Dickman Functional Impulsivity are included in the Sensation Seeking category rather than Specific Forms. Although domain-general effect sizes for the other five domains were computed, aggregation of this domain would violate the distinctiveness and specificity of the measures and was thus not performed. *Behavioural Measures* were included as a separate domain to maintain the distinction between psychometric self-report measures and behavioural tasks. This domain included: Executive Response Inhibition

tasks (e.g. the Stop Task); Visual-cognitive tasks (e.g. the Matching Familiar Figures Test); The Iowa Gambling Task; Delay Discounting; and the Balloon Analogue Risk Task. For a description of these tasks, see Table 17.

Statistical Analysis

Statistical Independence. The requirement of independence of observations means that the same sample could not be included multiple times when computing an aggregate effect size. Many studies used multiple measures of impulsivity. Aggregating studies by measure does not violate this requirement of independence. However in the domain-level analysis, where multiple measures from a sample were grouped in the same domain, the mean of the d values for the measures were included. Effect sizes and variance ratios were calculated for all categories and domains.

Mean difference effect sizes. Formulae for calculating effect sizes were taken from Lipsey & Wilson (2001). For reported measures, Cohen's d was calculated (by dividing the difference between male and female means by an estimate of the pooled standard deviation).

$$d = \frac{\bar{x}_{male} - \bar{x}_{female}}{sd_{pooled}}$$

Four effect sizes were reported by the authors. Where d values were not reported by the author, d was calculated either by converting existing parametric statistics such as F (15 effect sizes), t (12 effect sizes), or r values (72 effect sizes), or directly from published or provided means and standard deviations (559 effect sizes). Seventy-nine values were estimated as 0 where non-significant gender differences were reported but no relevant statistics could be located. In the Results section, summary effect sizes including and excluding these conservatively estimated d values are reported. Following convention, female means were subtracted from male means so that positive d values represent higher male than female scores.

Outliers, heterogeneity and moderator analysis. Outliers were identified on a category-by-category basis as follows. Cases where the effect size was estimated as 0 due to insufficient data were removed. Z-scores were calculated for the remaining d values. Values of d with z scores outside the range of -2.5 and 2.5 were classified as outliers and subsequently removed from analysis. Results are reported both including and omitting outliers.

The heterogeneity statistic, Q, was calculated for each analysis. Q statistics test for equality of effect sizes within each analysis, and follow a chi square distribution with k -1 degrees of freedom (Hedges & Olkin, 1985). A simplified formula is as follows:

$$Q = \sum_{i=1}^{k} w(d_i - \bar{d})^2$$

Where $w = \frac{1}{v}$, $= \frac{N_{male}+N_{female}}{N_{total}} + \frac{d^2}{2(N_{total})}$, and k is the number of effect sizes.

Significant Q statistics are indicative of the presence or absence of a non-heterogeneous dispersion between effect sizes, but not the magnitude. Q can be sensitive to sample size (Higgins & Thompson, 2002; Hardy & Thompson, 1998), and its significance is expected when analyzing considerable numbers of studies (Higgins, 2008). Heterogeneity is incorporated into estimates of effect size via random effects models.

Random Effects Model. Random effects models make the assumption that the variation between studies is attributable not only to sampling differences between studies, but other, unspecified influences within studies. It assumes effect size parameters to be randomly sampled and estimates these parameters based on the population (but see Schulze, 2004). The random effects model is particularly appropriate when effect sizes are significantly heterogeneous. The conceptual background of this study (reviewed in the Introduction) suggested that heterogeneity within the various measures and domains was likely and so a random effects model was implemented a priori.

Moderator analyses were performed for each measure, the purpose being to explore study variables potentially accounting for variability in effect sizes. Significant Q statistics were not considered prerequisites for running a moderator analysis (see Rosenthal & DiMatteo, 2002). The moderator variables tested were as follows: age (grouped by mean age into five levels: 10-15 years, 15-18 years, 18-21 years, 21-30 years, 30-40 years, 40 years and over); population (grouped into three categories: university students, community samples, school samples); geographical area (grouped into three categories: USA, Canada & Central America; UK, Europe, Australia & New Zealand; Asia, Africa, & the Middle East); sex of first author; and publication status of the study. The test statistic for the moderator analysis is Q_B, which is analogous to the F statistic in ANOVA (Hedges & Pigott, 2004). A significant Q_B denotes that the effect sizes for the different subgroups in the analysis differ significantly.

Publication bias. In many of the studies retrieved for this meta-analysis, sex was not a variable of interest. This makes publication bias less likely. Nevertheless, the possibility of publication bias was explored where possible. Firstly, a moderator analyses was run to determine if effect sizes for published studies significantly differed from unpublished studies. Secondly, following Begg and Mazumdar (1994), the rank correlation between standard error (largely a function of sample size) and effect size for studies within domains was calculated. This is a statistical analogue of a funnel plot. The assessment of publication bias by any means is unreliable where the number of studies is small (Borenstein, Hedges, Higgins, & Rothstein, 2009), therefore this test was implemented only for categories with at least 20 studies.

Variance Ratios. These were calculated wherever sufficient data were available, resulting in 475 values. Ratios were computed by dividing the male variance by the female variance. Greater male than female variability is therefore reflected in values greater than one. Following previous authors (Else-Quest et al., 2006), ratios were transformed via base-10 log before calculating category means. Untransformed ratios are presented in Tables 19-23.

Statistical Software. d values and Q statistics were calculated using SPSS; while the random effects models, moderator analyses, and tests for publication bias were run using CMA Version 2 (Biostat Inc., 2008).

Results

Tables 19 to 22 report effect sizes by measure and associated statistics, as well as the overall effect size for the impulsivity domains to which they have been assigned: *Reward Sensitivity, Punishment Sensitivity Sensation Seeking and Risk Taking,and General Impulsivity.* We do not aggregate the results from *Specific Forms of Impulsivity* and *Behavioural Measures of Impulsivity* by measure because, in these domains,

aggregation would violate the distinctiveness of the measures. Results from these domains are presented in Tables 23 and 24, respectively. For a complete list of effect sizes and variance ratios for all studies, see Appendix 2. This Appendix also identifies the authors of the study, the N of males and females, moderator variables coded (age, population, geographical area, sex of first author, published or unpublished source) and the impulsivity measures used.

Table 25 shows the significant moderator variables for each measure. All moderators significant at $p<.05$ are reported in these tables but, because of the large number of analyses run and the consequent inflated likelihood of Type 1 errors, only those that were significant at $p < .01$ are discussed in the text. We also restrict our discussion of significant *variance ratios* to those where $p < .01$.

Reward sensitivity

Overall effect sizes. For the domain general analysis, there were 18 effect sizes, all but one of which were computed (Table 19). The overall effect size was negligible and non-significant (d = .01). However, there was marked variation in the direction and magnitude of effect sizes for specific measures.

The effect size for the BAS Total score was non-significant but slightly favored women (d = -.13). This was chiefly due to women's significantly higher scores on the BAS Reward subscale (d = -.27). The BAS Reward scale poses questions about emotional responsiveness (e.g. 'When good things happen to me, it affects me strongly'). Women outscored men even more strongly on the TCI scale of Reward Dependence (d = -.56). This scale, despite its name, is composed of subscales specifically assessing "sentimentality, social sensitivity, attachment and dependence on approval by others" (Center for Wellbeing, n.d.). These are areas where past research suggests women should score highly (Cross & Madsen 1997).

The female advantage on these scales stands in contrast to the sex difference favoring men on the SPSRQ and GRAPES Reward scales (d = .44). These latter two scales contain many items that oriented to competitive success and ambition (e.g. SPSRQ: "Are you interested in money to the point of being able to do risky jobs?"; GRAPES: "I expect that I will rise to the top of any field of work I am or will be engaging in"). Thus there appeared to be differences in the conceptualization and contextualization of reward that are potentially confounded with masculinity and femininity.

The remaining two BAS scales (Drive, d = .06 and Fun, d = .08) were non-significant. Again, this might be related to the way in which the constructs are operationalized. While the Drive scale appears to have an appetitive component reflecting ambition, it differs from the SPSRQ in that it does not refer specifically to money or status. Instead, the item wording is, again, very general (e.g. "I go out of my way to get things I want"). The Fun scale contains items that appear to tap impulsivity (e.g. 'I often act on the spur of the moment'). It is therefore perhaps unsurprising that the modest effect sizes on these two scales were very much in line with that found for the domain of General Impulsivity (see *General Impulsivity*).

Table 19: Sex differences (d) in measures of reward sensitivity

Measure	*d*	95% CI	*k*	N men	N women	*Q*	VR (*k*)
SPSRQ/GRAPES							
All studies	.42	.33/.52	9	1091	2443	13.57	1.05 (9)
Computed only[a]	.44	.36/.53	8	1068	2358	9.83	
TPQ/TCI Reward Dependence							
All studies	-.56	-.68/-.44	4	437	841	2.22	1.08 (4)
BAS Total							
All studies	-.13	-.38/.12	4	420	537	9.13*	0.80 (4)
BAS Drive							
All studies	.06	-.04/.15	9	1201	1372	9.19	0.96 (9)
BAS Fun							
All studies	.08	-.01/.17	9	1201	1372	8.71	1.08 (9)
BAS Reward							
All studies	-.27	-.41/-.13	9	1201	1372	19.35*	0.95 (9)
Total of reward sensitivity measures							
All studies	.01	-.17/.19	18	2380	3598	340.90***	
Computed only[a]	.01	-.18/.20	17	2357	3513	340.86***	1.03 (44)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Avila & Parcet (2000) * $p < .05$. ** $p < .01$. *** $p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

Moderator analysis. Only the BAS Total and the BAS Reward scale showed significant heterogeneity. Moderator analyses were performed on all measures (see Table 25). Only one was significant at $p < .01$: age moderated the sex difference in BAS Reward, with the sex difference being smaller for samples aged 18-21 years (d = -.16) than for the 21-30 age group (d = -.54).

Variance ratios. Mean anti-log variance ratios can be found in Table 19. None are significantly different from 1.

Punishment sensitivity

Overall effect sizes. For the domain general analysis, there were 18 independent effect sizes, all but one of which were computed (Table 20). There was a significant, small-to-moderate, effect size favoring women (d = -.33) although, once again, there was variation in the magnitude as a function of the measure used.

All three measures showed a difference in favor of women, two of which were significant. TCI Harm Avoidance (d = -.43) assesses feelings of anxiety in unpredictable situations (e.g. "Usually I am more worried than most people that something might go wrong in the future"). The gist of the item content is very similar to that of the BIS, on which there was a moderate to large sex difference (d = -.63). BIS items are also concerned with anxiety in the face of failure (e.g. 'I feel worried when I think I have done poorly at something important',

'If I think something unpleasant is going to happen I usually get pretty "worked up".) Both TCI Harm Avoidance and the BIS therefore assess emotional responses to actual or anticipated punishment.

Table 20: Sex differences (d) in measures of punishment sensitivity

Category	*d*	CI	*k*	N men	N women	*Q*	VR (*k*)
SPSRQ/GRAPES							
All studies	-.11	-.23/.00	9	1136	2563	18.50*	0.97 (9)
Computed only[a]	-.12	-.24/.01	8	1113	2478	18.31*	
TPQ/TCI Harm avoidance							
All studies	-.43	-.52/-.33	5	784	1391	4.43	1.08 (4)
BIS of BIS/BAS							
All studies	-.63	-.74/-.52	8	1026	1197	8.65	1.14 (8)
Total of punishment sensitivity measures							
All studies	-.32	-.45/-.19	18	2598	4091	119.46***	1.05 (21)
Computed only[a]	-.33	-.47/-.20	17	2575	4006	117.63***	

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Avila & Parcet (2000)

* $p < .05$. ** $p < .01$. ***$p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

The aggregated effect size for SPSRQ and GRAPES measures was again in the female direction but only approached significance (d = -.12). Many of the GRAPES items appear to tap pessimism and anticipatory worry in a similar way to the above scales (e.g. "When there is a disease going around, I worry about getting it", "In light of all the crime in the world. I expect to be the victim of a mugging or an assault at some point during my life."). However the SPSRQ items seem to capture social assertiveness versus shyness (e.g. ("Would you be bothered if you had to return to a store when you noticed you were given the wrong change?", 'Do you generally avoid speaking in public?') The content therefore appears to be more associated with extraversion-introversion, on which we would not expect a marked sex difference (Costa et al., 2001; Schmitt, Realo, Voracek, & Allik, 2008).

Moderator analysis. Only the effect sizes for punishment sensitivity as measured by the SPSRQ or GRAPES scales showed significant heterogeneity. Moderator analyses were performed on all categories. Age moderated the sex difference on the BAS Reward Scale, such that the sex difference was more pronounced in the 21-30 age group (d = -.54) than the 18-21 age group (d = -.16).

Variance ratios. Mean anti-log variance ratios can be found in Table 5. None are significantly different from 1.

Sensation seeking and risk taking

Overall effect sizes. Table 21 reports effect sizes for the aggregated domain of sensation seeking and risk taking and the 13 measures which it subsumes. For the domain general analysis, there were 130 independent

effect sizes, of which five were estimated as zero. The effect size was small to moderate in size with significantly higher sensation seeking and risk taking among men (d = .41).

Table 21: Sex differences (d) in measures of sensation seeking and risk-taking

Measure	*d*	95% CI	*k*	N men	N women	*Q*	VR (*k*)
Eysenck Venturesomeness							
All studies	.49	.43/.56	49	7443	10553	160.99 ***	0.91* (41)
Computed only[a]	.51	.44/.57	47	7349	10395	146.80 ***	0.91* (41)
Outliers removed[b]	.53	.47/.59	45	7267	10232	118.02***	0.91* (39)
SSS Total							
All studies	.48	.41/.56	22	2563	3072	31.56	0.95 (17)
Computed only[c]	.50	.43/.56	21	2541	2992	27.36	0.95 (17)
SSS Thrill & Adventure Seeking							
All studies	.41	.29/.54	16	2761	3498	69.39 ***	0.85 (14)
SSS Experience Seeking							
All studies	.01	-.11/.12	10	1406	2021	18.27*	1.04(8)
Computed only[d]	.01	-.11/.12	9	1385	1998	18.27*	1.04(8)
SSS Disinhibition							
All studies	.52	.40/.65	15	2286	3007	52.02***	1.26 (13)
Computed only[d]	.54	.42/.66	14	2265	2984	48.73 ***	1.26 (13)
Outliers removed[e]	.57	.46/.69	13	2204	2965	38.93 ***	1.37** (12)
SSS Boredom Susceptibility							
All studies	.20	.09/.31	14	1922	2764	36.58***	1.07 (11)
UPPS Sensation Seeking							
All studies	.48	.33/.63	15	1566	2284	62.44 ***	0.95 (11)
Computed only[f]	.49	.34/.65	14	1552	2262	60.39 ***	
Dickman Functional Impulsivity							
All studies	.24	.08/.39	11	935	1346	27.59 **	1.04 (9)
ZKPQ Impulsive Sensation Seeking							
All studies	.19	-.22/.60	4	623	706	58.30 ***	1.21(4)
KSP Monotony Avoidance							
All studies	.15	-.00/.29	4	269	510	0.27	0.85 (4)
MPQ/PRF Harm Avoidance							
All studies	-.78	-.92/-.64	3	334	528	0.11	0.91 (3)
Risk Taking							
All studies	.36	.29/.44	11	3739	3330	25.66*	
Computed only[g]	.38	.31/.44	10	3659	3250	20.00	1.10* (7)
Sensation Seeking Other Measures							

All studies	.21	.11/.30	24	5694	6748	236.92***	1.08 (23)
Computed only[h]	.22	.13/.32	22	5432	6428	229.67***	
Total of sensation seeking measures							
All studies	.39	.35/.43	130	23402	28914	578.23***	0.99 (169)
Computed only[i]	.41	.37/.45	125	22952	28334	607.19***	
Outliers removed[j]	.41	.37/.45	123	22815	28154	274.42***	1.00 (164)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Leshem & Glicksohn (2007); Reynolds et al (2006a).

bRemoved (in order): Clarke (2004); Rim (1994).

cRemoved: Lennings (1991)

dRemoved: Lundahl 1995

eRemoved: Curran (2006)

fRemoved: Verdejo-garcia et al (2007)

gRemoved: Sahoo (1985)

hRemoved: Lennings (1991); Overman et al (2004)

iRemoved: Leshem and Glicksohn (2007); Reynolds et al (2006a); Verdejo-garcia et al (2007); Sahoo (1985); Lennings (1991); Overman et al (2004); Lundahl (1995); Lennings (1991).

jRemoved: Curran (2006: Sensation Seeking Scale- experience seeking; ZKPQ Impulsive Sensation Seeking); Weyers et al (1995: age 27: TPQ Novelty Seeking); Lundahl (1995: Sensation Seeking Scale – Thrill and Adventure Seeking); Curran (2006: Sensation Seeking Scale –Boredom Susceptibility); Copping (2007); McAllister et al (2005).

* $p < .05$. ** $p < .01$. ***$p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Turning to the measures subsumed in this domain, ten of the thirteen measures had significant sex differences and all reflected greater sensation seeking by men. The largest effect size was for MPQ and Personality Research Form (PRF; Jackson, 1994) measures of Harm Avoidance (d = -.78). The MPQ Harm Avoidance questionnaire offers respondents a choice between two somewhat aversive activities from which they select the one that they would least like to undertake (e.g. 'Having to walk around all day on a blistered foot' or 'Sleeping out on a camping trip in an area where there are rattlesnakes'). This scale appeared to magnify the sex differences found on the similarly structured SSS Thrill & Adventure which differs in offering a positive choice between two alternatives (e.g. 'I would like to try surfboard riding' or 'I would not like to try surfboard riding').

Four of the measures showed moderate sex differences including I7 Venturesomeness (d = .51); SSS Total (d = .50); SSS Disinhibition (d = .57); SSS Thrill & Adventure Seeking (d = .41); and UPPS Sensation Seeking (d = .49). Slightly lower effect sizes were found for Risk Taking (d = .38); Dickman Functional

Impulsivity (d = .24); and Sensation Seeking Other Measures (d = .22). The ZKPQ ImpSS scale includes items separately assessing impulsivity and sensation seeking and the effect size of .19 was non-significant with high heterogeneity (based on 4 studies). The two scales measuring intolerance of monotony showed quite small effect sizes; SSS Boredom Susceptibility (d = .20) and KSP Monotony Avoidance (d = .15). SSS Experience Seeking which captures a desire for novel but safe activities showed a non-significant effect size of .01. This provides more evidence that it is reference to risk taking which produces sex differences.

Moderator analysis. For most of the measures within the domain of sensation seeking and risk taking, there was significant heterogeneity. The exceptions were: SSS Total, Risk Taking, KSP Monotony Avoidance and MPQ/PRF Harm Avoidance. Moderator analyses were performed for all measures (see Table 25).

The sex difference on Eysenck's I7 Venturesomeness scale appears to be moderated by age. With the exception of a small number of samples aged 30-40 (d = .84), the largest effect sizes are present in the 15-18 (d = .63) and the 18-21 (d = .54) age groups, with effect sizes in the other age groups ranging from .37 to .46. This suggests that, in general, the sex difference in Venturesomeness is largest in young adults. No other moderators were significant in this domain.

Variance ratios. Mean anti-log variance ratios can be found in Table 21. Only the variance ratio for SSS Disinhibition is significantly larger than 1 ($p < .01$), indicating greater male variability on this measure. There is little evidence for greater male then female variability in general within this domain.

Measures of general impulsivity

Overall effect sizes. Although the domain general effect size was significant, it was extremely small in magnitude (d = .08), indicating slightly higher levels of impulsivity in men.

Table 22 shows the mean weighted effect sizes for each of the four measures included in this domain. There was no significant sex difference on Eysenck-based measures of impulsiveness. The Karolinska Scales of Personality (KSP) impulsivity scale was also non-significant. While the sex differences on the BIS-11 Total, (d = .12), and on Impulsivity Other Measures, (d = .13), showed men to be significantly more impulsive, the effect sizes were again small in magnitude.

Table 22: Sex differences (d) in general measures of impulsivity

Measure	*d*	95% CI	*k*	N men	N women	*Q*	VR (*k*)
Eysenck Impulsiveness							
All studies	.03	-.00/.07	100	14425	19680	222.72***	1.00 (74)
Computed only[a]	.04	-.00/.08	88	13603	18768	222.27***	1.00 (74)
Outliers removed[b]	.03	-.01/.07	82	13427	18584	183.63***	0.97 (68)
BIS Total							
All studies	.11	.05/.16	58	6296	8452	115.14***	0.99 (42)
Computed only[c]	.12	.06/.19	48	5729	7561	110.68***	0.99 (42)
Outliers removed[d]	.12	.06/.18	47	5702	7548	105.88***	1.01 (41)
KSP Impulsivity							
All studies	-.06	-.19/.07	7	826	4452	8.83	0.79* (5)
Computed only[e]	-.06	-.21/.10	5	789	4318	8.38	0.79* (5)

Measure	*d*	95% CI	*k*	N men	N women	*Q*	VR (*k*)
Impulsivity Other Measures							
All studies	.12	.07/.17	54	30040	31403	345.60***	1.02 (38)
Computed only[f]	.13	.08/.19	47	29379	30575	344.99***	1.02 (38)
Outliers removed[g]	.14	.08/.19	46	29354	30535	338.78***	1.02 (38)
Total of general impulsivity measures							
All studies	.07	.05/.10	206	50805	62428	244.52***	1.00 (159)
Computed only[h]	.08	05/.11	180	48862	59859	359.28***	
Outliers removed[i]	.08	.05/.11	173	48688	59683	131.42*	0.98 (153)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Allen et al (1998); Brown et al (2006); Deffenbacher et al (2003); Doran et al (2007a); Keilp et al (2005); Ketzenberger & Forrest (2000); Leshem and Glicksohn (2007); Reynolds et al (2006a); Reynolds et al (2007); Van den Broek et al (1992).

bRemoved (in order): Weyers et al (1995: age 50); Saklofske & Eysenck (1983: age 15); Weller (2001); Starrett (1983: Senior high); Corr et al (1995); Lopez Viets (2001).

cRemoved: Allen et al (1998); Chung & Martin (2002); Dinn et al (2002); Hulsey (2000); Jack & Ronan (1998); Leshem and Glicksohn (2007); Nagoshi et al (1994); Neubauer (1992); Patock-Peckham et al (1998); Reynolds et al (2006a); Rigby et al (1992); Van den Broek et al (1992).

dRemoved (in order): Clark et al (2005).

eRemoved: Lennings (1991); Lennngs & Burns (1998).

fRemoved: Allen et al (1998); Bembenutty & Karabenick (1998); McMahon & Washburn (2003); Overman et al (2004); Plouffe & Grawelle (1989); Rhyff et al (1983); Schweizer (2002).

gRemoved (in order): Malle & Neubauer (1991).

hRemoved: Allen et al (1998); Allen et al (1998); Allen et al (1998); Bembenutty & Karabenick (1998); Brown et al (2006); Chung & Martin (2002); Deffenbacher et al (2003); Dinn et al (2002); Doran et al (2007a); Hulsey (2000); Jack & Ronan (1998); Keilp et al (2005); Ketzenberger & Forrest (2000); Lennings (1991); Lennngs & Burns (1998); Leshem and Glicksohn (2007); Leshem and Glicksohn (2007); McMahon & Washburn (2003 - NB notes); Nagoshi et al (1994); Neubauer (1992); Overman et al (2004); Patock-Peckham et al (1998); Plouffe & Grawelle (1989); Reynolds et al (2006a); Reynolds et al (2007); Rhyff et al (1983); Rigby et al (1992); Schweizer (2002); Schweizer (2002); Schweizer (2002); Schweizer (2002); Van den Broek et al (1992); Van den Broek et al (1992).

iRemoved: Weyers et al (1995; 50-year olds); Clark et al (2005); Saklofske & Eysenck (1983: 15-year olds); Malle & Neubauer (1991); Weller (2001); Starrett (1983: Senior High sample); Corr et al (1995).

* $p < .05$. ** $p < .01$. ***$p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Moderator analysis. For all measures within the domain of general impulsivity except the KSP Impulsivity measure, there was significant heterogeneity. Moderator analyses were performed on all measures (see Table 25). Population moderated the sex difference in KSP impulsivity. The two community samples showed a small but significant sex difference in the female direction (d = -.18), while there was no sex difference in University samples.

Variance ratios. Mean anti-log variance ratios can be found in Table 22. None of them are significantly different from one at $p < .01$.

Specific forms of impulsivity

Overall effect sizes. Nine measures of specific forms of impulsivity were analyzed, giving a total of 128 independent effect sizes (111 of which were computed) from 56 studies. Table 23 shows the mean weighted effect sizes for these measures. For most of the measures, there was no sex difference. There were significant but small sex differences in the male direction on: BIS-11 Cognitive Impulsivity (d = .13), indicating men's greater difficulty in concentrating and focusing attention; on BIS-11 Non-Planning (d = .15), suggesting men's lesser tendency to consider the future; and on Dickman's Dysfunctional Impulsivity (d = .12), which captures a failure of premeditation resulting in negative consequences. There was a small to moderate effect size on Impulsivity / Carelessness in the Social Problem Solving Inventory (SPSI, d = .32), indicating that men are more likely than women to rush into ill-considered 'solutions' to interpersonal problems. There was also a small but significant sex difference in the female direction on UPPS Urgency (d = -.10), indicating that women report greater difficulty in controlling their impulses in the face of negative affect. The overall picture is that there are weak, inconsistent sex differences in these specific forms of impulsivity.

Moderator analysis. For most of the specific measures of impulsivity, there was significant heterogeneity in the effect sizes. The exceptions were: UPPS Premeditation, UPPS Urgency, Dickman Dysfunctional Impulsivity, and the SPSI. Moderator analyses were performed for all measures. Table 25 presents those categorical variables that were found to have a significant moderating effect on the sex difference.

Table 23 : Sex differences (d) in measures of specific forms of impulsivity

Category	d	95% CI	k	N men	N women	Q	VR (k)
BIS Cognitive							
All studies	.13	.00/.26	18	1776	2372	56.79***	0.92 (16)
BIS Motor							
All studies	.08	-.00/.17	19	2990	3620	34.09*	1.04 (13)
BIS Non-planning							
All studies	.15	.06/.24	20	3187	3839	43.31 **	0.96 (17)
UPPS Perseverance							
All studies	.05	-.07/.17	14	1449	2111	34.27**	0.93 (12)
Computed only[a]	.05	-.08/.17	13	1435	2089	34.26***	
UPPS Premeditation							
All studies	-.01	-.08/.06	14	1449	2111	7.77	1.06 (12)
Computed only[a]	-.01	-.08/.06	13	1435	2089	7.77	
Outlier removed[b]	-.00	-.07/.07	12	1423	2031	3.40	1.00 (11)
UPPS Urgency							
All studies	-.10	-.19/-.01	14	1449	2111	19.15	.94 (12)
Computed only[a]	-.10	-.19/-.01	13	1435	2089	19.06	
Dickman Dysfunctional Impulsivity							

Category	d	95% CI	k	N men	N women	Q	VR (k)
All studies	.12	.02/.23	12	1107	1518	16.58	.91 (10)
Impulse Control							
All studies	.02	-.22/.25	11	1303	1767	92.15***	0.85 (9)
Computed only[c]	.02	-.23/.26	10	1277	1743	92.09***	
Social Problem Solving Inventory (SPSI)							
All studies	.23	.09/.37	6	990	1850	11.37*	1.05 (5)
Computed only[d]	.32	.23/.41	5	869	1199	2.80	

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Verdejo-Garcia et al. (2007).

bRemoved: Anestis et al. (2007).

cRemoved: Fox et al (2007).

dRemoved: Maydeu-Olivares et al. (2000)

* $p < .05$. ** $p < .01$. *** $p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (*k*) = mean variance ratio (number of sample sizes from which variance ratios could be calculated)

The sex difference in BIS Non-Planning was moderated by geographical area, with samples from the US, Canada, and Central America showing a moderate sex difference in the male direction (d =.30), and samples from the UK, Europe, Australia, and New Zealand showing no sex difference. The sex difference in UPPS Lack of Perseverance was moderated by age: the sex difference in the male direction appears only in samples aged over 21 (d = .38). In UPPS Urgency, age also moderated the magnitude of the sex difference in an inconsistent fashion. Here, an effect size in favor of women was confined to the age 15-18 age group (d = -.31). The significant moderation by population sampled may be an artifact of this age effect; the effect size was significant and in the female direction for the school samples, (d = -.26), but not for undergraduate samples.

The sex difference in Impulse Control also appears to be moderated by age, but in an inconsistent fashion. The two samples aged 15-18 show roughly equal sex differences in opposite directions, resulting in an overall null result, samples aged 18-21 show a sex difference in the male direction (d = .40), while samples aged over 21 show a small sex difference in the female direction (d= -.17). Geographical area also appears to moderate the sex difference in impulse control: the two samples from the UK, Europe, Australia and New Zealand show a substantial sex difference in the female direction (d = - .55), while those from the US, Canada, and Central America show a small sex difference in the male direction (d = .17).

Variance ratios. Mean anti-log variance ratios can be found in Table 23. None were significantly different from 1.

Behavioural measures of impulsivity

Overall effect sizes. The 48 studies in this domain produced 64 independent effect sizes, of which 43 were computed. Effect sizes are presented in Table 24. A significant sex difference, moderate in size and in the

male direction, was found on the BART (d = .36). This suggests that men are willing to continue the pursuit of a reward in the face of increasing risk for longer than women. Since the BART is a measure of risk taking, it is not surprising that the significant sex difference is consistent with those found in the general domain of sensation seeking and risk taking.

On the IGT, men were found to perform significantly better (i.e. less impulsively) than women (d = -.34). This, in contradiction to developmental and evolutionary predictions relating to effortful control, suggests that women are less able than men to resist a monetary reward in the short term in order to avoid a greater monetary loss later. However, it should be noted that the IGT was not designed to assess impulsivity but decision making. Bechara, Damasio, Damasio, and Anderson (1994: 8) noted that a patient who performed poorly on the IGT due to damage to the prefrontal cortex was "not perseverative, nor is he impulsive". Men's superior performance on this task may actually be the consequence of women's greater punishment sensitivity: there is evidence that women prefer an IGT strategy which minimizes the frequency of punishment, even though this may be disadvantageous in the long run (Goudriaan, Grekin, Sher, 2007). This raises questions about the validity of attributing poor performance on this task uniquely to impulsivity. Delay discounting, also used as a measure of the propensity to resist small short-term rewards as part of a long-term strategy, showed no sex difference. Although this is consistent with our finding that general measures of impulsivity did not differ between the sexes, it should be noted that delay discounting measures only one of the many facets thought to be subsumed by the construct of impulsivity (Smith & Hantula, 2008). Correlations between delay discounting and psychometric measures of impulsivity are typically weak (Reynolds et al., 2006; Smith & Hantula, 2008).

Table 24 : Sex differences (d) in behavioural measures of impulsivity

Category	d	95% CI	k	N men	N women	Q	VR (k′)
Executive response inhibition							
All studies	.13	-.04/.30	19	863	974	84.54***	0.94 (19)
Computed values only[a]	.21	-.06/.48	10	592	647	83.21***	0.94 (19)
Visual-cognitive tasks							
All studies	-.20	-.37/-.04	7	1558	1408	172.46***	0.92 (8)
Computed values only[b]	-.26	-.43/-.08	6	1499	1285	156.43***	0.92 (8)
Iowa Gambling Task							
All studies	-.19	-.35/-.03	7	602	725	15.56*	-
Computed values only[c]	-.34	-.48/-.20	4	380	420	4.31	-
Delay Discounting							
All studies	-.08	-.19/.02	21	905	882	40.52	0.95 (17)
Computed values only[d]	-.07	-.22/.07	15	783	751	39.70*	0.95 (17)
BART							
All studies	.30	.11/.49	10	265	311	21.12*	1.37 (3)
Computed values only[e]	.36	.16/.57	8	220	266	18.93*	1.37 (3)

Note: Effect sizes are in the male direction if positive and in the female direction if negative.

aRemoved: Acheson et al (2007); Brown et al (2006); de Wit et al (2002); Feldman (1999); Keilp et al (2005); Marczinski et al (2007); Reynolds et al (2006a); Tinius (2003); Walderhaug (2007).

bRemoved: Leshem and Glicksohn (2007).

cRemoved: Davis et al (2007); Goudriaan et al (2007); Jollant et al (2005).

dRemoved: Acheson et al (2007); Allen et al (1998); de Wit et al (2002); Kollins (2003); eRemoved: Acheson et al (2007); Reynolds et al (2006a). Reynolds (2003); Reynolds et al (2004).

* $p < .05$. ** $p < .01$. *** $p < .001$

d = mean effect size weighted by sample size; CI = confidence interval; *k* = number of samples; *Q* = homogeneity statistic; VR (k′) = mean variance ratio (number of effects from which variance ratios could be calculated).

Where impulsivity is inferred from errors on visual-cognitive tasks, a sex difference in the female direction is found (d = -.26). The use of visuospatial tasks to infer impulsivity also raises problems of validity. These measures were not developed as measures of impulsivity but as tests of, among other things: spatial ability (the SODT-R; Quiroga et al, 2007); intelligence (The Porteus Maze; Porteus, 1950; The Tower of London Test; Shallice, 1982); and visual attention (the Trail Making Test; Reitan, 1958). Although the MFFT was developed to measure a form of impulsivity, concerns about its construct validity have been raised before (Block et al, 1974). Attributing errors on visuospatial tasks to impulsivity may be particularly misleading where sex differences are of interest: the sex difference in visuospatial ability is one of the most robust in the literature (Voyer, Voyer, & Bryden, 1995), so a sex difference on these tasks might well be due to this difference in ability rather than impulsivity.

Consistent with Bjorklund and Kipp's (1996) review, no sex differences were found on Executive Response Inhibition Tasks. As outlined in previous sections, these included Stroop tasks, the Stop task, and the Go/no-go task. These tasks are not direct measures of impulsivity but of attention (MacLeod, 1991); inhibitory motor control (Band & van Boxtel, 1999); and passive avoidance learning (Newman, Widom, & Nathan, 1985), respectively. Correlations between these measures and psychometric measures of impulsivity are often weak or absent (Casillas, 2006: Enticott et al, 2006; Reynolds, Ortengren, et al, 2006; Reynolds, Richards, et al, 2006; Rodriguez-Fornells, Lorenzo-Seva, & Andres-Pueyo, 2002; but see Logan, Schachar, & Tannock, 1997). It has been suggested that performance on the stop task may only be impaired when trait impulsivity is exceptionally high (Enticott et al., 2006) so that using them to infer impulsivity in normal populations may be problematic.

Moderator analysis. Moderator analyses were run for the BART, delay discounting, and Executive Response Inhibition (there were too few studies to run moderator analyses for the IGT or the visuospatial tasks). The results are presented in Table 25. Although small numbers of studies mean that these results must be interpreted with caution, both the analysis by age and the analysis by population suggest that the sex difference in Executive Response Inhibition is moderated by age. A sex difference in the male direction is present in younger samples (age 10-15 years, d = .71; school samples, d = .62), while older samples (21-30 years) show no significant sex difference, or a small sex difference in the female direction (community samples, d = -.18). This suggests that, on these tasks, boys may lag behind girls in their ability to inhibit prepotent responses earlier in life, before catching up later on.

Table 25: Categorical analysis of all measures, grouped by domain

Measure and category	d (95% CI)	Q_w	k	Q_B
	General Impulsivity Measures			
Eysenck Impulsiveness				
Age				12.77*
10-15 years	.07 (-.01/.15)	13.88	12	
15-18 years	.06 (-.09/.20)	40.90 ***	11	
18-21 years	.03 (-.02/.09)	45.51*	27	
21-30 years	.09 (.02/.16)	37.52*	23	
30-40 years	-.06 (-.34/.23)	14.14 **	5	
40+ years	-.21 (-.37/-.05)	7.79	5	
BIS Total				
Geographical Area				6.71*
US, Canada & Central America	.18 (.09/.26)	68.46 ***	32	
UK, Europe & Aus/NZ	.05 (-.04/.13)	17.01	13	
Asia, Africa, Middle East	.04 (-.03/.11)	0.64	3	
KSP Impulsivity				
Population				7.26 **
University Students	.07 (-.09/.23)	0.86	4	
Community	-.18 (-.27/-.09)	0.69	2	
Geographical area				6.56*
US, Canada & Central America	.09 (-.09/.26)	0.69	2	
UK, Europe & Aus/NZ	-.17 (-.25/-.08)	1.59	5	
	Specific Measures of Impulsivity			
BIS Non-planning				
Geographical Area				17.26 ***
US, Canada & Central America	.30 (.20/.40)	11.11	11	
UK, Europe & Aus/NZ	.02 (-.07/.11)	7.80	8	
UPPS Perseverence				
Age				13.99 **
15-18 years	-.03 (-.16/.11)	0.48	2	
18-21 years	-.01 (-.18/.15)	15.12*	7	
UPPS Urgency				
Population				6.85**
University Students	-.03 (-.14/.07)	10.38	9	
Schools (up to age 18)	-.26 (-.14/.07)	0.18	2	
Age				15.62 ***
15-18 years	-.31 (-.45/-.17)	0.56	2	

Measure and category	d (95% CI)	Q_w	k	Q_B
18-21 years	.02 (-.07/.12)	1.88	7	
21-30 years	-.14 (-.32/.04)	0.41	3	
Geographical area				6.66*
US, Canada & Central America	-.04 (-.14/.07)	10.42	9	
UK, Europe & Aus/NZ	-.24 (-.36/-.12)	0.85	4	
Sex of first author				5.93*
Female	-.02 (-.14/.10)	9.55	7	
Male	-.22 (-.33/-.11)	1.71	6	
Impulse control				
Age				21.98 ***
15-18 years	.00 (-.74/.74)	26.33 ***	2	
18-21 years	.40 (.27/.54)	2.43	3	
21-30 years	-.17 (-.36/.03)	0.36	2	
Geographical Area				9.18 **
US, Canada & Central America	.17 (-.02/.35)	32.40 ***	8	
UK, Europe & Aus/NZ	-.55 (-.98/-.13)	4.19*	2	
	Sensation Seeking and Risk-taking			
I7 Venturesomeness				
Age				26.12 ***
10-15 years	.46 (.35/.58)	18.84*	9	
15-18 years	.63 (.44/.81)	0.82	3	
18-21 years	.54 (.43/.65)	27.99 **	11	
21-30 years	.46 (.33/.58)	51.37 ***	60	
30-40 years	.84 (.70/.98)	1.33	3	
40+	.37 (.21/.53)	4.29	4	
	Reward and Punishment Sensitivity			
BAS Reward				
Age				9.75**
18-21 years	-.16 (-.29/-.04)	6.35	5	
21-30 years	-.54 (-.73/-.34)	0.02	2	
	Behavioural Measures of Impulsivity			
BART				
Age				6.65*
10-15 years	.43 (.02/.85)	1.15	2	
18-21 years	.57 (.30/.85)	0.12	3	
21-30 years	.02 (-.30/.34)	0.65	3	

Measure and category	d (95% CI)	Q_w	k	Q_B
Executive Response Inhibition				
Population				17.37 ***
Community	-.17 (-.40/.06)	0.82	4	
Schools (up to age 18)	.62 (.46/.78)	7.58	4	
University Students	.05 (-.18/.28)	0.35	2	
Age				30.69 ***
10-15 years	.71 (.51/.92)	0.22	2	
15-18 years	.32 (-.36/1.01)	5.34*	2	
21-30 years	-.19 (-.44/.05)	0.47	3	

Note: Only significant moderators are shown.

* $p < .05$. ** $p < .01$. *** $p < .001$

QW = total within-group variance. *QB* = variance between contrasted categories.

Variance ratios. Mean anti-log variance ratios can be found in Table 24. Men were found to vary more widely than women on Stroop-related tasks. No other variance ratios were significantly different from 1.

Publication bias

Sex differences were not the object of study in most of the studies retrieved for this meta-analysis and the likelihood of publication bias is therefore reduced. Nonetheless, two methods were employed to check for the possibility of publication bias. Firstly, where at least three effect sizes from unpublished studies could be located within a category, a moderator analysis was run to determine whether the effect size found in unpublished studies differed from that found in published studies. Secondly, a rank correlation between standard error and effect size was computed for any category where *k* was larger than 20. As stated in the Method, this is a statistical analogue of inspecting a funnel plot, and a significant correlation can be taken as evidence of publication bias. The results of these analyses are presented in Table 26. There was no evidence for publication bias in any of the domains.

Discussion

We organize our discussion in terms of the theoretical distinction made in the Introduction between lower-order (reward and punishment sensitivity) and higher-order (effortful control) theories of impulsivity. We then consider sex differences in variance ratios. We end with a summary and suggestions for future developments in the field.

Reward and Punishment Sensitivity in relation to Sensation Seeking.

The aggregate measure of *reward sensitivity* showed no significant sex difference. However it appears that various measures within this domain are measuring very different constructs. On the TCI, items refer specifically to social sensitivity and attachment, and the effect size favoring women probably reflects the greater salience of this domain to women. This is also true of the BAS Reward Scale, where much emphasis is placed on the strength of emotional responses to positive events. There is evidence that women experience emotions

more intensely than men and are more willing to articulate them (Brebner, 2003: Vigil, 2009), which may account for women's higher scores. In contrast, the SPSRQ/GRAPES scales emphasize strong pursuit of reward, particularly in the form of money or status, and here a sex difference favoring men is observed. This sex difference fits well with the predictions outlined in the introduction regarding men's greater approach motivation in the pursuit of dominance.

Table 26: Evaluation of evidence for publication bias using moderator analysis by publication status and rank correlation between standard error and effect size.

Domain/measure	Effect size (95% CI) by publication status					Rank Correlation[a]	k	Evidence for publication bias
	Published	k	unpublished	k	Q_B			
General impulsivity								
Whole domain	.07 (.04/.10)	159	.14 (.04/.25)	21	1.61	0.01 (p = .45)	180	None
I7 Impulsiveness	.03 (-.01/.08)	80	.11 (-.04/.26)	8	0.92	0.02 (p = .39)	88	None
BIS Total	.12 (.06/.19)	44	.06 (-.13/.25)	4	0.43	0.10 (p = .16)	48	None
Impulsivity Other Measures	.12 (.06/.18)	38	.19 (.04/.34)	9	0.67	-0.01 (p = .44)	47	None
Specific measures of Impulsivity								
BIS Non-planning	Insufficient studies for analysis by group					0.06 (p = .36)	20	None
Sensation Seeking and Risk-Taking								
Whole domain	.39 (.34/.44)	107	.37 (.22/.53)	17	0.05	-0.05 (p = .20)	127	None
I7 Venturesomeness	.51 (.44/.57)	44	.58 (.03/1.13)	3	0.07	-0.01 (p = .45)	49	None
SSS Total	.52 (.44/.60)	16	.45 (.31/.60)	4	0.64	-0.09 (p = .29)	20	None
Sensation Seeking Other Measures	Insufficient studies for analysis					-0.09 (p = .26)	23	None
Reward Sensitivity	Categories too small to evaluate							
Punishment Sensitivity	Categories too small to evaluate							
Behavioural Measures	Categories too small to evaluate							

[a]Gives the rank order correlation between standard error and effect size. All p values are one-tailed.

Where sex differences in reward sensitivity are of theoretical interest, the choice of reward sensitivity measure is crucial. It is essential to consider what, if any, particular form of reward is most relevant. It must also

be made clear whether 'sensitivity' to reward refers to the extent to which reward is *liked*, or the extent to which reward is *pursued*. Our data suggest that this subtle difference in operationalizing 'sensitivity' can lead to sex differences in opposite directions.

Measures of *punishment sensitivity* were consistently in the female direction, although the effect size varied from small to moderate. Although the differences between measures were less dramatic than for reward sensitivity, we found again that measures with a stronger emphasis on emotion produced larger sex differences in the female direction. This suggests that the extent to which we observe sex differences in punishment sensitivity depends on the extent to which measures refer specifically to fear and anxiety, rather than to general dislike or avoidance. As with reward sensitivity, the selection of the appropriate instrument to measure punishment sensitivity will depend on the context of the research.

Explanations of *sensation seeking and risk taking* have drawn on these lower order theories in terms of affective and neurochemical responses to prospective reward and punishment. It is in the domain of sensation seeking that sex differences were most marked. Sensation seeking is a trait characterized by strong affective motivation — unlike impulsivity, where the presence of affective motivation is ambiguous. We propose that sensation seeking —and its cousins novelty seeking, risk taking, fun seeking, venturesomeness, and reversed harm avoidance — constitute a distinctive trait that should not be subsumed under the general concept of impulsivity. At a conceptual level, Zuckerman's definition of sensation seeking makes no reference to acting without deliberation. Zuckerman himself has noted that parachute jumpers do not jump from planes on impulse; they plan carefully, checking their equipment, drop site, parachute, and timings. As operationalised in most self-report questionnaires, sensation seeking items do not make reference to the failure of deliberation which is the hallmark of impulsive action. Empirically, impulsivity and sensation seeking frequently appear as distinct factors in multivariate analyses. Depue and Collins (1999), reviewing 11 factor analytic studies of major personality scales, found that sensation seeking, novelty seeking, and risk taking scales showed a distinct clustering and were only loosely associated with scales measuring 'non-affective' impulsivity. Several other studies using a range of impulsivity scales have also identified a factor of sensation seeking distinct from other aspects of impulsivity (Flory, Harvey, Mitropoulou, New, Silverman, Siever et al., 2006; Magid & Colder, 2007; Miller, Joseph & Tudway, 2004; Smith et al., 2007; Whiteside & Lynam, 2001; Zelenski & Larsen, 1999). The fact that sensation seeking loads on a distinct dimension argues as much for its statistical and conceptual distinctiveness as it does for its status as a facet of impulsivity. In the present analysis, it was noticeable that sex differences were considerably weaker on the ZKPQ ImpSS than on the SSS-V. This suggests that greater risk-related content produces stronger sex differences. When factor analyzed, ImpSS splits into its two constituent factors of impulsivity and sensation seeking (Zuckerman and Kuhlman, n.d.). This may account for the dilution of the effect size on this measure with weaker sex differences in impulsivity counteracting the stronger sex differences in sensation seeking.

Within the domain of sensation seeking and risk taking, we found some encouraging evidence of consistency between psychometric and behavioural measures. The BART task was developed as a measure of risk taking (Lejuez, Read, Kahler, Richards, Ramsey, Stuart, et al, 2002), and there is good evidence for its construct validity (Aklin, Lejuez, Zvolensky, Kahler, & Gwadz, 2005; Hunt, Hopko, Bare, Lejuez, & Robinson, 2005). It is not surprising that this task shows a significant sex difference in the male direction. Unlike the

behavioural tasks which measured a failure to inhibit a pre-potent response, the BART measures the active pursuit of reward. In a factor analytic study, the BART has been found to be distinct from executive inhibition tasks (Reynolds, Ortengren et al., 2006). This adds to the empirical evidence for a distinction between impulsivity and risk taking.

Evolutionary theories, predicated on differential parental investment, predict higher risk taking by males and these are supported by the current review. Greater male risk taking is not unique to our species, and such a conserved and sex-specific evolutionary adaptation is likely to be instantiated at a relatively low level in terms of neural structure. Emotional and motivational factors are sufficient to generate individual differences in appetite for and aversion to risk. Within the evolutionary framework, a distinction can be drawn between Campbell's argument that women are more sensitized than men to negative outcomes (punishment sensitivitv) and Daly and Wilson's argument that men experience a greater positive attraction to risk (reward sensitivity).

Campbell's position is supported by our finding that women were consistently higher in measures of punishment sensitivity. Women's risk aversion was evident also in their markedly higher scores on MPQ Harm Avoidance. On this measure, in which respondents choose the less objectionable of two aversive activities, the effect size (d = -.78) is almost twice as big as that found on the SSS Thrill & Adventure scale (d = .41), which offers an appetitive choice regarding engagement in risky activities. This suggests that women may be even more prone to avoid risky activities than men are to seek them out.

In a meta-analysis of sex differences in risk taking, Byrnes et al. (1999) found greater risk taking by men over a range of paradigms but these were most marked in studies involving real rather than hypothetical risk. In reference to the distinction between higher-level cognitive and lower-level motivational processes, they note "…the processes involved in the transition of cognitions to behaviours (e.g. fear responses) may explain gender differences in risk taking more adequately than the cognitive processes involved in the reflective evaluation of options" (Byrnes et al., 1999, p.378). They propose that these lower-level motivational factors may play as strong a role as cognition in risky decision making. This "risk as feelings" idea was developed by Loewenstein et al. (2001), who noted that emotional reactions to risk can and frequently do occur without cognitive intervention, and that sex differences in fear and anxiety underlie women's more cautious, risk-averse decisions (Lerner & Keltner, 2000). In the areas of health maintenance and extreme sports (Harris, Jenkins & Glaser 2006), which present real threats to physical integrity, the sex difference in risk taking is best explained by women's greater anticipation of negative consequences and by their higher ratings of the severity of those negative consequences should they occur.

Although Campbell originally predicted women's greater fear specifically in the context of prospective physical injury, many studies have now demonstrated greater fear and anxiety in women across a range of contexts (see Campbell, 2006). Women exceed men cross-culturally on the Vulnerability (d = -.43) and Anxiety facets (d = -.36) of the NEO-R (Costa et al., 2001). Anxiety is strongly linked to a lower threshold for detecting and attending to threat, and experimental studies demonstrate this threshold to be lower in women than in men (McLean & Anderson, 2009).

Daly and Wilson's (1988) complementary thesis emphasizes men's greater attraction to risk. In this view, men engage in more dangerous activities as a result of the inherent attractions of the activities (e.g. scuba-diving, parachute jumping). Though it is evident why potentially life-threatening activities might promote fear

and avoidance, it is less clear why some individuals should find them inherently attractive. Daly and Wilson argue that men use such activities to advertise their courage as part of intrasexual competition, thus gaining greater reproductive success; this masculine taste-for-risk therefore represents an evolved module. Consistent with this is Zuckerman's argument that the physiological arousal resulting from such activities signals reward in the brain. Although measures of reward sensitivity do not provide unanimous support for this appetitive view, we note that men's scores do exceed women's where questionnaire items focus on competitive dominance striving.

The attraction of risky activities to men, however, need not depend upon heightened male sensitivity to reward but can be explained in terms of their lower punishment sensitivity as follows (Campbell, 2002). Typically an inverted U-shaped function describes the relationship between the arousal (low - high) generated by an activity and its subjective hedonic valence to the actor (pleasant - unpleasant). If men have a higher fear threshold, their function will be right-displaced relative to women's. Hence a higher degree of arousal will be necessary to generate the same degree of pleasure. Men will show a shift from enjoyment to excitement (and from apprehension to fear) at higher levels of arousal compared to women. Hence a high speed car ride that is unpleasant (aversive) to women could be exciting (attractive) to men.

Effortful control.

We consider g*eneral measures and specific forms of impulsivity* and *behavioural measures* as assessing higher-order or effortful control since they presuppose an explicit, conscious decision with regard to action or inaction. The sex difference in *general measures of impulsivity*, although statistically significant, was small in magnitude. The most widely used psychometric measure of general impulsivity, Eysenck's I7 Impulsiveness questionnaire, showed no significant sex difference. The analysis of *specific measures* added to the picture of weak, inconsistent sex differences in impulsivity. Measures of *behavioural impulsivity* were very inconsistent, with some suggesting greater female impulsivity, some suggesting greater male impulsivity, and some showing no sex difference. This inconsistency is likely to be due to variation in the constructs measured by these tasks.

Within the domain of higher order processes, it is relevant to highlight the distinction between 'hot' effortful control and 'cool' executive function control (Ardila, 2008; Happanay, Zelazo & Stuss, 2004; MacDonald 2008). Both are higher order processes governing subcortical processes.

Executive function governs cognition in emotionally neutral conditions and has been localized to the dorsolateral prefrontal cortex (Cummings 1993; Fuster, 1997). Many of the behavioural tasks included in our analysis assess this kind of inhibition, where impulsivity is manifested in an inability to inhibit motor responses, maintain attention, develop and execute a plan, or switch to a new dimensional set. Executive functions of this kind are correlated with general intelligence, where sex differences are likely to be minimal (Jensen, 1998). Our analysis suggests that sex differences are non-significant on these 'cool', executive function tasks (Stroop, Go/No-Go, Stop, CPT). The Delay Discounting Task also showed no sex difference. Although this task involves monetary incentives and might, therefore, be considered an affective task, we suggest that it relies primarily on the 'cooler' executive form of decision-making. In most studies, participants' choices are entirely hypothetical, since the high sums involved (e.g. $1,000) make it impossible to honor their choices. In other studies,

participants are told there is a small (e.g. 10%) probability that one of their choices might be honored (e.g. McLeish & Oxoby 2007), or one trial is randomly selected for payment (e.g. Reynolds, Richards et al., 2006). Given that participants make as many as 400 sequential choices, it is clear that the task has a strong hypothetical component. Hypothetical decisions draw on 'cooler' cognitive forms of decision-making which are assumed to be based on rationality and expected utility theory (Loewenstein, Weber, Hsee, & Welch, 2001; Madden, Begotka, Raiff & Kastern, 2003). In their meta-analysis, Byrnes, Miller, and Schafer (1999) found a very small tendency for men to make riskier decisions in these hypothetical choice-dilemma tasks (d = .07).

Although women demonstrated higher impulsivity in visual-cognitive tasks, this result should be treated with caution. Most of these tasks were not originally designed to assess impulsivity. By employing number of errors as the measure of impulsive responding, they conflate men's established superior visual spatial abilities with lower impulsivity (Voyer, Voyer, & Bryden, 1995). The findings from the IGT should also be treated with caution since, as we have noted, this was not originally designed as an impulsivity measure (Bechara et al., 1994) and the sex difference may reflect women's greater punishment sensitivity (Goudriaan et al., 2007).

'Hot' forms of inhibition refer to control over social and affective processes; the effortful control system. It has been localized to the orbitofrontal region of the prefrontal cortex which has bidirectional connections with limbic systems structures, notably the amygdala (Davidson, Putnam & Larson, 2000; Rolls, 2000). There is suggestive, though not yet conclusive, evidence that women may have an advantage in affective inhibition: women have greater binding potential for serotonin in several regions including the amygdala and orbitofrontal cortex (Parsey et al., 2002). They also have greater orbitofrontal volume (Goldstein et al., 2001; Wood, Heitmiller, Andreason & Nopoulos, 2008) and greater functional connectivity between the OFC and the amygdala (Meyer-Lindenberg, Buckholtz, Kolachana, Hariri, Pezawas, Wabnitz et al., 2006). Following MacDonald and Baumeister's argument that men's stronger appetitive impulses are less amenable to cortical over-ride, we anticipated sex differences in effortful control

The weak sex difference that we found (d = .08) begs the question of the extent to which psychometric impulsivity measures are accessing hot versus cold inhibitory control. This is not easy to determine. Questions of the kind "I am an impulsive person" do not indicate whether the relevant context is affectively loaded or neutral. Some respondents might interpret this item as referring to affectively 'hot' contexts such as a love affair or an argument; while others might think of a 'cool' context such as an ill-considered chess move. Any tendency for men to interpret items in one way and women in another could distort or obscure sex differences. Future studies could usefully examine whether sex differences are systematically moderated by the requirement for hot — as opposed to cool — behaviour control. This would entail clearer exposition of the factors that render a decision 'affective' rather than emotionally neutral. Consider an item such as "I plan tasks carefully". A negative response to this item might reflect a deficit in the 'cool' executive ability to plan or a social-affective 'hot' preference for spontaneity over predictability.

That said, the management of social interactions appears to be a strong candidate for affective effortful control. In accord with Bjorklund and Kipp's (1996) proposal, men are more impulsive than women in social problem solving. While this may, as Bjorklund and Kipp suggest, derive from the evolutionary advantages accruing to women who could suppress and conceal emotion toward others, it is also consistent with women's

greater interpersonal interests. Women have been credited with more sensitive social skills and with a stronger interpersonal orientation than men (Cross & Madson, 1997; Hall, 1984; Horgan, Mast, Hall & Carter, 2004; Su, Rounds & Armstrong, 2009). It may be that their superior performance results from a stronger dependence on, and motivation to sustain, social relationships. This might derive from evolutionary pressures associated with survival and childcare (Taylor, Klein, Lewis, Gruenewald, Gurung & Updegraff, 2000).

The distinction between executive function and effortful control might reflect more than simply the presence or absence of an affective component. Performance on executive function tasks is often referred to in terms of 'ability' or 'deficit', implying degrees of competence; impulsive actions are seen as 'failures' of effortful control. As with intelligence, more executive function is better than less. According to this view, sex differences in effortful control will produce male overrepresentation in problem behaviour due to men's greater propensity for 'failure' to act in a controlled manner. It is not clear, however, that effortful control should be viewed in this way. An overly strong effortful control system is associated with internalizing behaviour problems (Murray & Kochanska, 2002). Rather than a competence, effortful control might be best conceptualized as a personality style. In this case, actions which we construe as impulsive represent a preference which might in some circumstances be beneficial (Carver, 2005; Dickman, 1991; MacDonald, 2008). Stable individual differences will exist in the tendency to make a particular kind of choice, such as spontaneity versus restraint. As with other personality traits (Nettle, 2006), effortful control may be neither an unalloyed good nor an absolute hindrance; it may simply be something that varies between people. According to this trait view of effortful control, a sex difference in effortful control could account for both the overrepresentation of men and boys in externalizing pathologies and the overrepresentation of women and girls in internalizing ones. Understanding whether sex differences in effortful control represent competency failures or personality traits is important in addressing sex-linked social problems including aggression, substance misuse, and accidental deaths.

Our weak and inconsistent results for effortful control contrast with the very marked sex difference found in children (Else-Quest et al., 2006). Effortful control in children is measured with the Child Behaviour Questionnaire (Rothbart et al., 2001) by summing five scales which appear to asses 'cool' executive functions and avoidance of high sensory stimulation. In the former domain, effect sizes were small for the measures of attention focus (d = -.16) and attention shifting (d = -.31). Effect sizes reflecting tolerance for low levels of sensation were somewhat higher; perceptual sensitivity (detection of slight, low intensity stimuli, d = -.38), low intensity pleasure (enjoyment of situations involving low stimulus intensity d = -.29), and inhibitory control (capacity to suppress approach responses in uncertain situations or when instructed, d = -.41). These latter measures appear to capture aspects of (reversed) sensation seeking. It may be that the aggregated effortful control value (d = -1.01) disproportionately reflects these sex differences in sensation seeking and, if this is the case, is somewhat more consistent with our findings for adults. As noted previously, the Child Behaviour Questionnaire assesses Impulsiveness separately from effortful control as speed of response initiation (a facet of Extraversion / Surgency). Here, the effect size of d =.18 is only slightly higher than our adult values for several Impulsivity measures. Alternatively, differences in data sources may explain the apparent convergence of the sexes with age. In Else-Quest et al.'s (2006) meta-analysis the vast majority of the data came from parents' or

teachers' ratings of child behaviour. The larger sex difference they report might reflect gender stereotyping effects associated with third party reports, a possibility considered by the authors.

To the extent that sex differences in impulsivity do indeed narrow with age, differential neuronal maturation may be a candidate explanation. Both sexes acquire stronger inhibitory control as they move toward adulthood and this may be tied to the late maturation of prefrontal areas — especially the dorsolateral and ventromedial regions (Hooper, Luviana, Conklin & Yarger, 2004). Girls show an earlier maturation peak in frontal lobe areas but, during adolescence, boys show a sharper increase in grey matter reduction and white matter development (Giedd et al., 2006). There is also evidence that boys and girls may recruit different neuronal circuits to solve the same inhibitory control problem (Christakou et al., 2009); this could be usefully investigated in future work.

Variance ratios.

Archer and Mehdikhani (2003) proposed that traits which reflect sexually selected characteristics should show significantly greater variance among males than among females. This proposal stems from the fact that men have more freedom to vary in their sexual strategy in terms of offering high or low levels of paternal investment. Greater male variance, therefore, stems from the retention of both male strategies in the gene pool. Women, as a sex, are more constrained in the levels of maternal investment they must make, which results in lower intrasexual variance. Greater male than female variance has been found on a number of physical (Lehre et al., 2009) and psychological (Archer & Mehdikhani, 2003; Hedges & Nowell, 1995) measures. Operationally, sexual selection is inferred when the sexes vary in central tendency. Sensation seeking and punishment sensitivity are therefore candidates for examining Archer and Mehdikhani's thesis. Variance ratios did not differ significantly from 1 here or on other impulsivity measures, except on the SSS Disinhibition scale. This is surprising given that sex differences in risk taking are thought to arise from differential parental investment (Daly & Wilson, 1988). Furthermore, differences in central tendency strongly suggest the action of sexual selection. The exclusion criteria of the current analysis might account for this null finding. For reasons outlined in the preceding sections, we excluded clinical and incarcerated samples. This will have put a constraint on the observed variability. Given the overrepresentation of men and boys in pathological and criminal behaviour in which risk taking is a factor, it is not unreasonable to suggest that this constraint may affect the male variance more than the female variance, leading to a null result here. Our observation of equal variance is therefore inconclusive, rather than contradictory to Archer and Mehdikhani's thesis.

Summary and suggestions

Our results suggest that sex differences are most evident in low-level motivational responses captured by punishment and reward sensitivity, risk taking, and sensation seeking. Where human behavioural sex differences mirror those found in other species, the most likely neural sites are lower-level limbic system processes that are phylogenetically conserved. Greater risk taking by males is characteristic of a number of mammalian species (Daly & Wilson, 1983). For example, male common chimpanzees are more reckless, impulsive, and active than females (King, Weiss & Sisco, 2008). The present results suggest that it may be

women's greater sensitivity to — and anxiety about — the punishing consequences of risky action that deters them from the same level of engagement as men.

Sex differences are much smaller for effortful control and this suggests that it has been less subject to sexual selection. The ability to control the expression of emotions is key to sustaining the stable social groups on which both sexes depend (Barklay, 2001; MacDonald, 2008). The enlargement of the human neocortex has been attributed to the need for fast and flexible behavioural adjustment to unpredictable changes within the lifetime of the individual (Plotkin, 1997). Such demands have been as great for men as for women and where selection acts equally on both sexes, sex differences are not expected. The marked over-representation of men in aggressive and sexual social pathologies may tell us more about the strength of sexual selection acting on male sexuality and aggression than the natural selection pressures operating on impulse restraint.

We end with three lessons that we have learned from undertaking this analysis which we hope will be helpful in guiding future research.

Impulsivity is not unitary. In our introduction, we highlighted the distinctly non-unitary nature of impulsivity as a construct. Attempts to integrate various psychometric and behavioural measures into a coherent and replicable set of dimensions have not been entirely successful. This may be due to a heavy reliance on factor analysis: The pool of measures entered into the analyses varies between studies, so different results are produced. Elucidating the dimensionality of impulsivity requires convergent evidence: one promising route might be through imaging studies where the neural structures and circuits associated with different forms of impulsivity may indicate their distinctiveness (e.g. Dalley, Mar, Economidou & Robbins, 2008; Davidson, Jackson, & Kalin, 2000; Llewellyn, 2008; Meyer-Lindenberg et al., 2006; Smillie, 2008). Until such clarity is achieved, we can only urge caution. Our analysis shows that sex differences depend very much on the inventory or task that is employed. Generalizations from a specific measure to impulsivity more generally must be made tentatively and must acknowledge the multifaceted nature of the construct.

Impulsivity may be both 'hot' and 'cool. An important distinction within impulsivity is between different forms of higher-order control. Executive function is primarily concerned with cognitive aspects of impulsivity manifested in failures of attention maintenance and switching, and the establishment and reorganization of dimensional sets. These rely on different neural structure (dorsolateral prefrontal cortex) than those recruited in effortful control over emotional and affective states (orbitofrontal prefrontal cortex). We find no sex differences in the former and evidence of small differences in the latter. These conclusions must remain tentative until we have a clearer understanding of the extent to which various tasks and measures uniquely assess one system rather than the other. Behavioural tasks vary greatly in which system they engage and it is often unclear whether a given task is being processed affectively or cognitively. For example, there has been a tendency to assume that the use of monetary incentives is sufficient to render a task affective. It would be helpful to have this confirmed by neuroimaging studies, especially in regard to possible sex differences. The corresponding ambiguity in psychometric inventories arises from the use of non-specific item wording: "'I often act without thinking" can be interpreted to apply to cool executive disinhibition (e.g. careless mistakes in solving a mathematical problem) or to an override of affective effortful control (e.g. insulting your boss).

Impulsivity is not sensation seeking. There is a clear conceptual and empirical distinction between sensation seeking and impulsivity. Though there is little unanimity on the definition of impulsivity, it has been

variously described as acting without deliberation, failure to inhibit a prepotent response, lack of planning, and failure of perseverance. None of these characteristics applies to sensation seeking activities. We suggest that sensation seeking should be recognized as a dimension of personality distinct from impulsivity, rather than a trait subsumed by it. Our results provide support for this: they clearly indicate that sex differences are small for impulsivity but considerably more marked for sensation seeking. Using the two constructs interchangeably may produce misleading results with regard to sex differences.

Many impulsive actions are harmless; hugging someone out of happiness, buying a treat on impulse, or opting for a new dish at a restaurant are hardly dangerous. Parachuting, rock-climbing, or skiing, although risky, are not impulsive --- they require planning, training, and a measured consideration of the risk. Clearly, some actions may be both impulsive and risky: running across a road, having sex with a stranger, or accepting an offer of drink or drugs, for example (Campbell & Muncer, 2009). The assessment of actions which are both risky and impulsive is an area in need of attention. We believe that it is this form of impulsive risk taking — risky impulsivity — which is most likely to underlie aggressive and criminal behaviour.

Impulsivity, Sensation Seeking and Reproductive Behaviour: A Life History Perspective

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Abstract

Impulsivity has often been invoked as a proximate driver of different life-history strategies. However, conceptualizations of "impulsivity" are inconsistent and ambiguities exist regarding which facets of impulsivity are actually involved in the canalisation of reproductive strategies. Two variables commonly used to represent impulsivity were examined in relation to reproductive behaviour. Results demonstrated that sensation seeking was significantly related to strategy-based behaviour, but impulsivity (defined as a failure to deliberate) was only weakly correlated. The effect of impulsivity disappeared when sensation seeking was controlled. Sex differences emerged for sensation seeking but not impulsivity. We conclude that "impulsivity" is not a unitary trait and that clearer distinctions should be made between facets of this construct.

Keywords: Life History, Reproduction, Impulsivity, Evolution, Sensation Seeking

1. Introduction

Life History Theory (LH) proposes (and data confirm) that behaviours cluster together, forming predictable adaptive strategies contingent on experiencing environmental (un)certainty during development (Belsky, Steinberg, & Draper, 1991; Chisholm, 1999a). Research also links LHT to individual differences in personality, particularly "impulsivity". This study sought to investigate how "impulsivity" relates to LHT strategy in more detail on a large non-clinical population.

Impulsivity

Impulsivity is commonly defined as a "tendency to act spontaneously and without deliberation" (Carver, 2005, p.313). Conceptualizations of "impulsivity" vary tremendously, with Depue and Collins (1999, p.495) claiming it "comprises a heterogeneous cluster of lower order traits" including sensation seeking (Zuckerman, 1971), delay discounting (Mazur, 1987), venturesomeness (Eysenck & Eysenck, 1985) and lack of perseverance (Whiteside & Lynam, 2001), to name but a few (see Evenden, 1999). Many authors stress the multidimensional nature of impulsivity (e.g. Carrillo-de-la-Pena, Otero, & Romero, 1993; Whiteside & Lynam, 2001). Others note important conceptual differences between "impulsivity" constructs (Evenden, 1999; Cross,

Copping & Campbell, 2011), whilst research demonstrates that different "impulsivity" traits have different effects on behaviours (Derefinko, DeWall, Metze, Walsh, & Lynam, 2011). Other conceptual ambiguities also exist. Is "impulsivity" part of a higher order cognitive process (e.g. executive control) or is it a lower order trait contingent on affective motivation (Carver, 2005; Evans, 2008)? A variety of measures have been developed to investigate "impulsivity" constructs. However, studies indicate that self-report measures and behavioural measures do not correlate significantly and that measures may tap different functions (Carillo-de-la-Pena, et al., 1993; Reynolds, Ortengren, Richards, & de Wit, 2006). Precisely what is being measured in studies investigating "impulsivity" can therefore be ambiguous.

Life History Theory

LH theory suggests that resources in developmental environments are finite, forcing organisms to make allocation decisions that maximise fitness potential (see Kaplan & Gangestad, 2005). This creates trade-offs; an organism can spend more time maturing at the expense of reproductive lifespan, or shorten development and reproduce earlier at the expense of offspring quality. Research indicates that reproductive behaviours form part of a strategy calibrated to local environmental conditions. An individual in an uncertain environment will mature earlier, initiate sexual activity earlier and mate more frequently with multiple sexual partners (adopting a fast LH tempo). Fast strategists exhibit a host of other traits including, higher levels of aggression, a tendency to have more children, a shorter lifespan, lower IQ scores and more mental health problems (Chisholm, 1999a; Ellis, 1988; Rushton, 1995). Those developing in stable, predictable environments exhibit the opposite pattern of behaviour (adopting a slow LH tempo).

Many behaviours associated with LH strategies express sex differences. There are consistent cross-cultural sex differences in levels of aggression, with men universally being more aggressive (Archer, 2009; Bettencourt & Miller, 1996). Levels of mating-related behaviour, such as higher scores on the Sociosexuality Inventory, more energy expended on mating rather than parenting and stronger preferences for short term mating also show significant differences in the male direction (Buss & Schmitt, 1993; Jackson & Kirkpatrick, 2007; Penke & Asendorpf, 2008). These sex differences emerged due to differences in fitness variance exhibited by the sexes (Bateman, 1948) and evolved via sexual selection to enhance success in the competition for the survival of genetic lineages. A review by Ellis (1989) suggests that males exhibit more behaviour consistent with faster strategies than females due to androgen exposure.

Life History and Impulsivity

As behaviours are sensitive to environmental factors, a proximate mechanism that responds to changes in levels of certainty must exist. Proposals drawing upon various conceptualisations of "impulsivity" have been made. Chisholm (1999a, p.135) claimed that strategy development was guided by an individual's "time preference", an economic term encompassing multiple traits including "intertemporal choice [between alternatives with varying costs or benefits over time], impatience, impulsiveness, self-control and the inability to defer gratification". Figueredo et al. (2005) focused on risk taking and impulsivity measures which correlated negatively with a measure of slow LH strategy (mini-K) and impulse control which correlated positively with the "K Factor". Hill, Jenkins and Farmer (2008) examined future discounting which partially mediated the relationship between uncertain family environments and risk taking behaviours. Previous research therefore implicates some form of "impulsivity" in strategy formation. Like LH behaviours discussed earlier, many

"impulsivity" traits also show consistent sex differences. Sensation seeking (Cross, et al., 2011; Wilson & Scarpa, 2010), dysfunctional impulsivity (Cross et al., 2011) and risk taking measures (Byrnes, Miller & Schafer, 1999) indicate that men engage in more thrill seeking activities and take more risks than women. This suggests that sex differences in LH tempo may therefore be associated with sex differences in "impulsivity" traits.

Key questions remain however. Which particular traits are important and how do they relate to strategies? Do all "impulsivity" conceptualizations contribute uniquely and additively to the development of strategy-based behaviour or do some conceptualizations subsume others? Frederick, Loewenstein and O'Donoghue (2002) concluded that 'time preference' is unlikely to be a unitary construct due to weak correlations between different measures and behavioural indicators. Loewenstein, Weber, Flory, Manuck and Muldoon (2001) suggested instead that time preference is multi-dimensional with three constituent facets: impulsivity (spontaneous and unplanned activity), compulsivity (careful planning) and inhibition (restricting impulsive behaviour). A crucial objective in LH research should be to identify which traits are actually predictive of LH behaviours before endorsing them as proximate psychological mechanisms driving LH trajectories. This is the aim of the current study.

In this study, two measures of "impulsivity" were examined to determine which better predicts LH strategy; impulsivity and sensation seeking. These were selected because an analysis by Cross et al. (2011) indicates that they are likely to be distinct traits. This study defines "impulsivity" as a failure of deliberation measured by items including "I often do things on impulse" and (reverse-scored) "I usually think about what I am going to do before doing it" (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993). Impulsivity has been conceptualised in terms of a dual process model in which it represents inefficient higher-level inhibitory control over lower-level affective drive states. McDonald (2008) suggests that, for evolutionary reasons, males demonstrate a weaker ability to inhibit affective impulses than women. Neuroimaging studies indicate that affective activation in the amygdala is modulated by the orbitofrontal cortex (Wager, Davidson, Hughes, Lindquist, & Ochsner, 2008) and that testosterone attenuates orbitofrontal-amygdala connectivity (van Wingen, Mattern, Verkes, Buitelaar, & Fernandez, 2010; Volman, Toni, Verhagen, & Roelofs, 2011) reducing modulation of affective impulses. Sensation seeking focuses on desire for thrill and excitement, including items such as "I like to have new and exciting experiences and sensations even if they are a little frightening" and "I enjoy getting into new situations where you can't predict how things will turn out". In terms of dual process models, sensation seeking is thought to be a manifestation of lower-level affective and motivational systems governing approach behaviour.

This study asks whether LH decisions favouring a faster LH strategy are linked with deliberative failure, the pursuit of sensation or both. We aim to clarify which "impulsivity" conceptualisation is most closely associated with key life history milestones. Sex differences in strategy-based behaviours should also be reflected in any candidate "impulsivity" measures. In their meta-analysis, Cross et al. (2011) concluded that, whilst consistent and significant sex differences emerged in the domain of sensation seeking, impulsivity measures show weak or no sex differences. It is predicted that these findings will be replicated.

2. Method

Participants and data collection

Seven hundred and sixty one British adults were recruited via an independent marketing company to participate in an online questionnaire. Four hundred and nine participants were male (mean age = 40.47, SD = 8.62) and 352 were female (mean age = 37.94, SD = 8.77). Occupation was recorded via social grade categories: 49.9% A and B (high and intermediate managerial and professional), 39.9 C1 and C2 (clerical, administrative and skilled manual) 6.7% (unskilled & unemployed) and 3.5% unspecified. This is somewhat higher than the national average. No significant differences were found between these groups in variables examined in this study and occupation was discounted from further analyses. Participants were not remunerated for participation.

Measures

Impulsivity (*Imp*) and Sensation Seeking (*SS*) were measured using the Impulsive-Sensation Seeking sub-scale of the ZKPQ (*Imp-SS*, Zuckerman et al., 1993), a 19-item measure that consists of 11 sensation seeking and eight impulsivity items. The scale was designed to measure impulsivity and sensation seeking as part of a superordinate trait (Zuckerman, 1994) but factor analysis demonstrates that it splits into two distinct subscales (Zuckerman & Kuhlman, 1993). Responses are recorded in a binary true or false format. Subscale alphas were high: .82 for *SS* and .73 for *Imp*.

Participants were asked questions aimed at assessing reproductive strategy. These variables were theoretically appropriate given the focus of LH on accelerated reproductive schedules (see Belsky et al., 1991; Chisholm, 1999). The measures were: *Age of Puberty Category*: Participants were asked to indicate how old they were when they reached puberty, categorised on a Likert scale graded as (1), age 11 or earlier, (2), age 12, (3), age 13, (4), age 14, (5), age 15 and (6), age 16 or above. *Age of First Sex*: Participants were asked to specify at what age they first had sexual intercourse. *Number of Sexual Partners*: Participants were asked to indicate how many people they had had sexual intercourse with in their lifetime, categorised on a scale graded as (1) 0, (2), 1, (3) between 2 and 10, (4) between 11 and 20, (5), between 21 and 50, (6), between 51 and 100, (7) more than 100. This was adjusted to control for participant age by creating a new variable called *Rate of Partners*; calculated by subtracting *Age of Puberty Category* from chronological age to give an indication of reproductive lifespan to date in years. *Number of Sexual Partners* was then divided by reproductive lifespan to give an indication of the rate of partners per year. As *Number of Sexual Partners* is categorical, the lower bound number in each category was used for the basis of calculation.

Correlation analysis was conducted using IBM Statistics SPPS (Version 19). Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) were performed using AMOS (Version 19) and EQS (Version 6.1).

3. Results

Descriptive statistics are provided in Table 27 for all variables. CFA was used to determine the best measurement model for the *Imp-SS* scale. A unitary construct was compared to a model with two separate, correlated factors, representing the distinction between *SS* and *Imp*. Models were compared using a variety of fit statistics. Chi-square tests evaluate the significance of differences between the restricted and unrestricted sample covariance matrix. The CFI (Comparative Fit Index) compares the similarities between the model's covariance matrix and the matrix observed in the data. The Root Mean Square Error of Approximation (RMSEA) examines

overall model complexity. CFI values should be greater than .90 and RMSEA values should ideally be lower than .10 (Bentler & Bonett, 1980; Steiger, 1989). Table 2 represents fit statistics for both models and illustrates that a two factor solution fits more parsimoniously and is a significantly better model (X^2diff = 393.86, df diff = 1, p<.001). While seemingly clear that the two factor solution is better, fit statistics from maximum likelihood estimation were disappointing. It is important to recognise, however, that maximum likelihood estimation underestimates model fit when the model contains categorical variables (Bentler, 2005). The *Imp-SS* Scale is scored on an ordered categorical system, and so the current fit statistics will be an underestimate. Bentler (2005) argued that the best approach to this problem is to correct the test statistic while still using ML estimation. It has been shown that using ML and making Satorra-Bentler (1988) corrections yields reliable results (Di Stefano, 2002).

In order to provide appropriate fit statistics, data was re-analyzed using EQS6 (Bentler & Wu, 2002), which calculates the Satorra-Bentler corrections. From these statistics (Table 28), it is not only clear that a two factor model is a better fit but also that this represents an acceptable fit to the data from both the RMSEA and CFI. Accordingly, *Imp* and *SS* are treated as separate entities for further analysis.

Table 27: Means (and standard deviations) for all measures (N = 761)

Measure	Whole sample	Males	Females
Impulsive Sensation Seeking	8.46 (4.66)	8.74 (4.44)	8.13 (4.90)
Impulsivity	2.53 (2.12	2.48(2.06)	2.58 (2.19)
Sensation Seeking	5.92 (3.19)	6.25(3.08)	5.55 (3.29)
Age of Puberty Category	3.12 (1.31)	3.33 (1.24)	2.88 (1.33)
Age of First Sex	17.92 (3.19)	17.95 (3.35)	17.89 (3.01)
Rate of Partners	0.37 (0.73)	0.46 (0.87)	0.27 (0.52)

Table 28: Factor solution fit statistics (N=761)

Model	X^2	DF	X^2/DF	RMSEA	C.I.	CFI
Unitary	1042.18	152	6.86	.088	.08/.09	.75
Unitary*	959.83	152	6.28	.084	.08/.09	.78
Two Factor	648.32	151	4.29	.066	.06/.07	.79
Two Factor*	540.23	151	3.58	.058	.05/.06	.95

*Satorra-Bentler correction applied

Correlations between variables within this study are presented in Table 29. Intercorrelations between variables are as predicted by LH, with *Age of First Sex* correlating negatively with *Rate of Partners* and positively with *Age of Puberty Category*. *SS* and *Imp* are significantly correlated, r = .52. *Imp* and *SS* are also correlated significantly with *Age of First Sex* and *Rate of Partners*, correlations being stronger for *SS* than for *Imp* in both cases. The directions of relationships are also as predicted (with *Age of First Sex* decreasing and *Rate of Partners* increasing with increases in *SS* and *Imp*). The relationship between *Age of Puberty Category* and both *Imp and SS* is non-significant.

Table 29: Correlations of all variables (N=761)

	Impulsivity	Sensation Seeking	Puberty	Sex
Sensation Seeking	.52**			
Age of Puberty Category	-.04	-.04		
Age of First Sex	-.10**	-.20**	.26**	
Rate of Partners	.09*	.20**	-.02	-.22**

*p<.05, **p<.01

Males reported significantly higher rates of sexual partners than females (t(759) = -3.73, p = <.001). Females reached puberty significantly earlier on average than males (t(759) = -4.89, p=<.001). There was a significant sex difference for *SS* (t(759) = -3.06, p = <.01), but not for *Imp* (p > .05).

SEM was used to individually and simultaneously examine the independent effects of *SS* and *Imp* on LH variables to determine if contributed variances were unique. Models were specified by directly linking *Age of Puberty Category* to *Age of First Sex* and *Age of First Sex* to *Rate of Partners*. *Imp* and *SS* variables were then directly linked to *Age of First Sex* and *Rate of Partners*. Table 30 illustrates fit statistics for these models. Only the *SS* model meets the criteria for a good fit to the data and is significantly better than both the *Imp* model (X^2diff = 83.33, df diff = 33, p < .001) and the combined model (X^2diff = 576.08, df diff = 131, p < .001). The *Imp* model shows the least acceptable fit to the data, failing on all key indicators. *Imp* and *SS* models differ in terms of their relationship to LH variables. In the *SS* model, the relationships between *SS* and *Age of First Sex* and *Rate of Partners* are significant (p < .001), with β = -.21 and β = .18 respectively. R^2 values for these relationships are .11 and .08 respectively. Relationships between *Imp* and the two LH variables are weaker, with β = -.11 and β = .11 respectively and are non-significant (p > .01). R^2 values for these relationships are .08 and .06 respectively.

Table 30: Model comparisons (N=761)

Model	X^2	DF	X^2/DF	RMSEA	C.I	CFI	R^2 (Sex)	R^2 (Rate of Partners)
Imp-LH	377.83	43	8.79	.101	.10/.11	.74	.08	.06
SS - LH	294.50	76	3.88	.062	.05/.07	.90	.11	.08
Combined	870.58	205	4.24	.065	.06/.07	.82	.11	.08

*p<.001

When examined simultaneously, the beta weight strengths between the two impulsivity measures (controlling for their intercorrelation) and the LH indicators change considerably. The relationships between *SS, Age of First Sex* and *Rate of Partners* increase to β = -.27 and β = .19 respectively and are significant (p < .001). The relationship between *Imp* and the same variables however diminish considerably to only β = .08 and β = -.01 respectively. Both links are non-significant (p > .05). This suggests that *SS* subsumes the contribution of *Imp* in relation to LH variables and that *Imp* contributes no significant unique variance. R^2 values for these relationships are .11 and .08 respectively.

4. Discussion

The data indicate that sensation seeking is more closely related to LH traits than impulsivity. Sensation seeking is more predictive of outcome measures, shows stronger correlations with LH traits, subsumes contributed variance of impulsivity and demonstrates expected patterns of sex differences.

The greater importance of sensation seeking relative to impulsivity likely derives from differences in conceptualisation and the associated underlying psychological processes they assess. Measures of general "impulsivity" focus on lack of deliberation and planning failure. Sensation Seeking is distinct from these and makes no reference to acting without forethought. Zuckerman (1994) acknowledges that sensation seekers do not fail to plan (parachutists do not impulsively leave an aircraft without planning and preparation). Sensation seeking reflects affective motivation and increased appetite for risk. This link to affective risk taking likely makes sensation seeking more relevant to LH strategy than impulsivity. Those developing in harsh, uncertain environments must take more risks to secure their genetic lineage whether through an appetite for earlier, frequent reproductions with multiple partners or through risky resource competition with others. Measures gauging attraction to risk taking (such as sensation seeking) are therefore more likely to be predictive of LH tempo.

Sensation seeking and impulsivity differ in another important way; the relative importance of affective and cognitive processes. Impulsivity, as measured in this study, employs general items about planning that tap cognitive control of behaviour, whereas sensation seeking assesses affective attraction to risk. In dual process models, these two domains correspond to the distinction between reflective 'cold' processing (higher-order, analytic, controlled) and reflexive 'hot' processing, (lower-order, affective, motivational). The former system is seen as a uniquely human capability, while the second is evolutionarily older and shared with other species (Carver, 2005; Evans, 2008; MacDonald, 2008). It may therefore be that impulsivity items that assess deliberative failure (lacking affective elements) tap higher-level "cold" cognitive processes and, more importantly, that these are less central to LH behaviours than more ancient affective systems. Factor analytic studies confirm that impulsivity items (focusing on effortful deliberation) do not load on the same factor as measures of reward or incentive sensitivity associated with the reflexive system (Clark & Watson, 1999; Depue & Collins, 1999; Zelenski & Larsen, 1999). In their meta-analysis, Cross et al., found no sex differences on effortful control measures (including failure to deliberate) although men exceeded women on affectively-loaded sensation-seeking and risk-taking measures.

Sex differences in sensation seeking have been explained in relation to evolutionary theory. Wilson and Daly (1985) suggest that asymmetries in parenting effort constrain males to take more risks in pursuit of reproductive success. As such, males develop a "taste for risk", manifested across multiple domains, demonstrating fearlessness and survivorship that makes them attractive as mates whilst depriving other males of resources. Campbell (1999) suggests this is complemented by an evolved female propensity to avoid risk; infants are strongly dependent on maternal investment and women should avoid risks that might threaten their survival or wellbeing. Research shows that sex differences in risk taking increase in line with potential costs (Byrnes et al., 1999). Impulsivity items on the inventory employed in this study do not allude to risk and so sex differences would not be predicted to emerge. However sensation seeking items do and here sex differences are

found. In summary, impulsivity as a failure to deliberate bears only a weak association with both sex differences and associated LH strategy.

This study supports the idea that a global construct of "impulsivity" or "time preference" may not be useful in understanding LH strategy development. Rather, the evidence presented here suggests that sensation seeking and deliberative failure emerge as distinct (although correlated) traits with different impacts on LH behaviour. Combined with previous evidence of distinct subscales in the *Imp-SS* (Zuckerman & Kuhlman, 1993), differences in the magnitude of sex differences found in measures subsumed under the umbrella concept of 'impulsivity' (Cross et al., 2011), and the consistent demonstrations that sensation seeking items cluster together with only weak associations with impulsivity items (e.g. Depue & Collins, 1999), the argument for distinct constructs is compelling.

In LH theory, there is currently a lack of unanimity about the nature and role of "impulsivity" mechanisms. Chisholm emphasises the attraction of immediate reward over delayed returns (hinting at affective motives to behaviour). However, research on the traits comprising "time preference" (inter-temporal choice, delay of gratification etc.) tend to employ cognitive or emotionally neutral items (see Cross et al., 2011). Other LH studies offer different conceptualizations. For instance, impulse control is deemed important to Figueredo et al.'s (2005) K-Factor, but its precise role (whether as a cause or a correlate of LH traits) is not specified. Hill et al. (2008) identify sensation seeking (a proxy for temperamental vulnerability) as an indirect cause of weak future orientation which in turn gives rise to risk taking (comprised of "impulsivity" operationalized as loss of control and risky behaviour). In these three studies alone "impulsivity" traits are used as a global cause, a LH correlate, a behavioural outcome, a mediating mechanism and a biological vulnerability. Whilst it is clear that "impulsivity" constructs are involved in the development of LH strategies, their precise influence remains ill-defined in the evolutionary literature.

Limitations and conclusions

This study examined only two types of "impulsivity". Further work is needed to provide greater clarity regarding the many 'hot' and 'cold' facets of impulsivity from a LH strategy perspective. The variance explained by traits in the present study is small (ranging from six to eleven percent). It is feasible that another "impulsivity" trait is a better predictor of LH strategy. Although we found that the additive effect of these variables was no better than sensation seeking alone, different combinations of traits may produce different results. In addition to additive effects, future work could examine further the temporal order of their relationship over the course of childhood strategy development (Hill et al. 2008).

It is clear that sensation seeking and impulsivity are distinct entities (both conceptually and empirically) and are probably subserved by different psychological processes. Caution should be employed when using umbrella terms such as "impulsivity" because researchers make different assumptions about its meaning and employ very different (and often uncorrelated) measures. Future research would benefit from making more sensitive distinctions between related concepts (and measures) of impulsivity which may be associated with very different behavioural outcomes.

Conceptualizing time preference: A life-history analysis.

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Abstract: Life-history theory (LHT) has drawn upon the concept of "time preference" as a psychological mechanism for the development of fast and slow strategies. However, the conceptual and empirical nature of this mechanism is ill-defined. This study compared four traits commonly used as measures of "time preference" (impulsivity, sensation seeking, future orientation and delay discounting) and evaluated their relationship to variables associated with life-history strategies (aggressive behaviour and mating attitudes, biological sex, pubertal timing, victimisation and exposure to aggression in the environment). Results indicated that only sensation seeking consistently showed all the predicted associations, although impulsivity, future orientation and delay discounting showed some significant associations. A unidimensional higher-order factor of "time preference" did not adequately fit the data and lacked structural invariance across age and sex, suggesting that personality traits associated with LHT do not represent a global trait. We discuss the use of personality traits as measures in LHT and suggest that greater caution and clarity is required when conceptualising this construct in future work.

Keywords: Life-History Strategies, Time Preference, Impulsivity, Sensation Seeking, Delay Discounting; Future Orientation; Aggression.

Introduction

Life-History Theory (LHT)

LHT is an evolutionary framework addressing phenotypic variation (see Ellis, Figueredo, Brumbach & Schneider, 2009; Stearns, 1992). Phenotypic variation is not infinite and is constrained by trading-off limited resources between traits (Roff, 1992). As fitness is measured via successful reproduction, a principal life-history decision is age of reproductive onset. Organisms can terminate investment in growth and reproduce early, expanding reproductive windows at the expense of lower accumulated capital for parenting. Alternatively, delaying reproduction allows somatic growth and resource accumulation but shortens reproductive windows. Age-specific mortality rates affect trade-offs (Ellis et al., 2009; Promislow & Harvey, 1990) because reproduction first requires

survival. Organisms' development thus balances reproductive optima with avoiding fitness cliffs. Mortality rates differ across age and environments, making reproductive timing decisions sensitive to risks of premature death.

LHT principles have been applied to explaining variation among humans (e.g. Belsky, Steinberg & Draper, 1991; Chisholm, 1999a; Ellis et al., 2009). It has been proposed that individuals detect cues to mortality either directly from the local environment (Wilson & Daly, 1997) or via familial stress manifested through weak attachments (Belsky, Steinberg & Draper, 1991; Chisholm, 1999a), predisposing the adoption of a 'faster' developmental trajectory. This is achieved by earlier pubertal onset, coitus, and willingness to engage in risky behaviours such as aggression and short-term couplings (Chisholm, 1999a; Ellis, et al., 2009). According to Chisholm (1999a), fast strategists (those who have suffered greater environmental and familial stress) express a "time preference" that prioritises short-term consumption over long-term investment, leading to riskier, but evolutionarily functional behaviours. The nature of "time preference" forms the core of this paper.

Time Preference

Chisholm's (1999a, p.135) "time preference" is an economic term synonymous with "intertemporal choice [between alternatives with varying costs or benefits over time], impatience, impulsiveness, self-control and the inability to defer gratification". The concept is often used interchangeably with "time perspective" and "time horizon" (Wilson & Herrnstein, 1985) and is proposed to be the psychological mechanism supporting strategic decision-making during development (Chisholm, 1999a). Those with shorter time preferences consume resources in the present. Present consumption protects against possible future fitness cliffs. In environments where mortality risks are high (Chisholm, 1999a, and later, Ellis et al., 2009), early reproduction and willingness to take risks may be functional, because capitalising on resources and opportunities in the present can ensure fitness returns. Deferring investment may bring no return at all through premature death. From a fitness perspective, individuals living under high mortality conditions have the least to lose and the most to gain from increased aggression and mating effort in the present, optimising fitness in response to beliefs about reproductively uncertain[17] futures (Chisholm, 1999a).

Schechter and Francis (2010) found that measures of future orientation were positively related to longer life expectancy and negatively related to childhood attachment problems and risk-taking attitudes. Kruger, Reischl and Zimmerman (2008) demonstrated that time preference mediated relationships between measures of developmental environments and measures of aggression and criminality (corroborated by Hill, Jenkins & Farmer, 2008). Self-assessed life expectancy has shown predicted correlations with life-history behaviours; shorter life expectancies were associated with more aggression, risky behaviour and earlier reproductive behaviour (Chisholm, 1999a; Copping, Campbell & Muncer, 2013a; Wilson & Daly, 1997; Wilson & Herrnstein, 1985).

Chisholm (1999a) conceptualised time preference with reference to several psychological traits, most of which fall under the umbrella concept of "impulsivity". "Impulsivity" constitutes a "heterogeneous cluster of lower-

[17] Recent theoretical and experimental works now conceptualise Chisholm's concept of environmental uncertainty as separate dimensions of harshness and unpredictability (Ellis et al., 2009). As environmental factors can be simultaneously harsh and unpredictable (and this is true for measures implemented in this study), these dimensions are difficult to disentangle at the measurement level. For clarity, this study maintains Chisholm's terminology of 'uncertainty' or 'stress' throughout unless explicitly stated otherwise.

order traits" (Depue & Collins, 1999, p.495). Others have also stressed the multi-faceted nature of the construct (Evenden, 1999; Cross, Copping & Campbell, 2011). Based on weak correlations between different measures, Frederick, Loewenstein and O'Donoghue (2002) concluded that "time preference" is likely multidimensional: a proposition supported by others (Smith & Hantula, 2008; Teuscher & Mitchell, 2011). Loewenstein, Weber, Flory, Manuck and Muldoon (2001) claimed that the construct consists of three facets; impulsivity (spontaneous/unplanned activities), inhibition (restricting impulses) and compulsivity (planning). Frederick et al., (2002) argued that intertemporal choice (between immediate smaller rewards and delayed larger rewards) results from multiple, competing processes and motives: a single discounting rate applicable to all choices is unlikely. Wilson and Daly (2006, p.993) concluded that a unitary construct reflecting time horizon is "not a psychological reality" based on results comparing offenders and non-offenders that were inconsistent with predictions.

The use of the constructs "time preference" and "impulsivity" has been historically inconsistent. For instance, Hill et al. (2008) invoke sensation seeking (as a measure of heritable temperament) as indirectly causing weaker future orientation, which in turn increases risky behaviour and impulsivity. All these traits are conceptually subsumed under "time preference" yet in this one study, these facets variously represent biological vulnerability, a mediating mechanism and a behavioural outcome. The role of "impulsivity" is similarly unclear in psychometric LHT measures (Figueredo et al., 2005) with some but not all facets of this construct acting as correlates (but not causes) of fast/slow strategies.

Empirical findings based on the measurement of traits constituting "time preference" (such as delay discounting and time perspective) have sometimes contradicted LHT predictions, particularly in aggression research where violent or juvenile offenders are no more present-orientated than non-violent offenders or community samples (Brennan, Moore & Shepherd, 2010; Nagin & Pogarsky, 2004; Wilson & Daly, 2006 although see Brezina, Tekin & Topalli, 2009). Chisholm (1999a) claimed that "time preference" should be sensitive to age and sex, with younger individuals and males demonstrating the highest rates of future discounting. However, this has not always been supported by research findings. Sex differences rarely emerge (Cross et al., 2011) whilst elderly rather than young individuals often discount more heavily (Read & Read, 2004; Trostel & Taylor 2001). Fawcett, McNamara and Houston (2011) in a review of the animal literature, proposed that discounting is not exponential and is instead context dependent and contingent on the availability and consistency of reward.

Whilst lower-order traits constituting "time preference" and "impulsivity" are implicated in LHT, conceptual confusion and empirical overlap of these umbrella terms create difficulties in identifying psychological mechanisms. This exploratory study aimed to conceptually untangle components of "time preference" and investigate their association with life-history variables.

Identifying psychological mechanisms

According to Chisholm, "time preference" is the mediator between environmental stress and behaviour. Psychological mechanism(s) that represent it should demonstrate the following associations. Whilst, these are not necessarily criteria for evaluating all potential life history variables, they should apply to aggression and mating behaviours based on Chisholm's hypothesis.

1) *Associations with life-history behaviours such as aggression and mating attitudes*. As "time preference" is the hypothesised mediating mechanism underpinning behavioural expression, candidate traits failing to demonstrate such associations may be rejected.

2) *Associations with reproductive onset*. If a shorter "time preference" results from earlier puberty (or the converse), pubertal age would be expected to show significant associations with a candidate "time preference" trait(s).

3) *Associations with environmental stressors.* Chisholm (1999a) claimed local mortality rates impact upon family instability and disrupt attachment bonds, conveying levels of environmental stress indirectly to developing children. If "time preference" is a response to environmental stress, it should demonstrate associations with indicators of stressful environments.

4) *Sex differences*. Evolutionary principles emphasise a role of biological sex in attachment processes, personality and behavioural expressions of life-history variables, particularly aggression and sexual activity (Archer 2009; Copping, Campbell & Muncer, 2013b; Del Giudice, 2009a). Differences in reproductive variances between the sexes form the basis of these differences, with reproductive outcomes being more variable for males than females (Bateman, 1948; Trivers, 1972) encouraging greater male risk taking and impulsivity to secure reproductive fitness (Wilson & Daly, 1985); the opposite being true for females (Campbell, 1999). Indeed, Chisholm (1999a) claimed that sex would be a key factor in "time preference".

Several traits have been associated with a faster life-history tempo. A review of these traits in relation to the above four criteria follows.

Sensation Seeking

Sensation Seeking (SS) is defined as "the need for varied, novel and complex sensations and experiences and the willingness to take social risks for the sake of such experience (Zuckerman, 1979; p. 10)". It is often regarded as synonymous with impulsivity and risk taking, despite evidence to the contrary (Cross et al., 2011; Copping et al., 2013b). Aggression and antisocial behaviours correlate positively with levels of SS (Wilson & Scarpa, 2010), as do risky sexual behaviours and mating strategies (Donohew, Zimmerman, Cupp, Novak, Colon & Abell, 2000; Seto, Lalumiere & Quinsey, 1995). Sex differences in SS are evident (Cross et al., 2011). Higher rates of SS have been associated with indices of environmental stress (Gatzke-Kopp, Raine, Loeber, Stouthamer-Loeber & Steinhauer, 2002). SS is also negatively correlated with pubertal onset (particularly in males: Khurana et al., 2012; Steinberg et al., 2008).

Impulsivity

Impulsivity represents a lack of deliberation. Typical questionnaire items include "I often get into trouble because I don't think before I act" and "I will often say what comes into my head without thinking first". Impulsivity is negatively correlated with age of first sex (McAlister, Pachana, & Jackson, 2005) and positively related to physical and verbal aggression (Vigil-Colet & Codorniu-Raga, 2004). Sex differences are evident but weak (d = .12; Cross et al., 2011). Stressful environments may contribute to impulsivity via interaction with genetic variants associated with impulsivity (Reif et al. 2011). Measures of impulsivity show expected relationships with pubertal onset (Khurana, Romer, Betancourt, Brodsky, Giannetta & Hurt, 2012).

Future Orientation

Future Orientation (FO) describes several related cognitive, attitudinal and motivational processes (see Steinberg, O'Brien, Cauffman, Graham, Woolard & Banich, 2009), representing the ability to comprehend, predict and plan for the future. Although 'future orientation' is invoked as a mediator in LHT, studies often use proxies such as life expectancy (Chisholm, Quinlivan, Peterson & Coall, 2005; Wilson & Daly, 1997) or hopelessness (Bolland, 2003). FO is correlated with aggression and sexual activity (Bolland, 2003; Cabrera, Auslander & Polgar, 2009; Wilson and Daly, 1997). Women are more future orientated than men (Kruger et al., 2008; Schecter & Francis, 2010; Steinberg et al., 2009) and economically disadvantaged individuals show weaker future orientations (Nurmi, 1987, 1992). Life expectancy has shown expected relationships with female pubertal onset (Chisholm et al., 2005).

Delay Discounting

Delay Discounting (DD) describes a preference for short-term over long-term gains where subjective reward value decreases with increases in receipt delay (Mazur, 1987). Respondents are presented with choices between small, immediate rewards and larger, delayed rewards and indicate reward preference whilst delay periods are varied. Rewards can be hypothetical or real. DD is related to risky behaviours, including aggression and sexual risk taking, (Reimers, Maylor, Stewart & Chater, 2009). Sex differences have been found in measures of DD but their magnitude varies considerably (Cross et al., 2011). Discounting is also influenced by resource scarcity (Griskevicius, Delton, Robertson & Tybur, 2011; Griskevicius, Tybur, Delton &Robertson, 2011). Measures of discounting also show expected correlations with pubertal onset (Khurana et al., 2012).

Current Study

The current exploratory study aims to evaluate Chisholm's conceptualisation of "time preference" to determine if one latent construct encompassing all four suggested traits exists. Traits were also examined individually to determine which trait best meets the criteria for a mediating psychological mechanism.

Materials and Methods

Participants

Seven hundred and forty one individuals (306 males and 435 females) recruited from schools, colleges and universities participated in an online questionnaire. Their mean age was 16.87 (SD = 5.59). Participants had to be age 13 or above and to have reached puberty in order to participate (for ethical reasons). No exclusion criteria or incentives were used.

Measures

Measures are described below. Confirmatory factor analysis (CFA) was conducted on all measurement indicators where a latent factor was assumed. Models were evaluated by the following criteria: X^2 values should be non-significant, RMSEA (measuring model complexity) should be .05 or below (Browne & Cudeck, 1993) and CFI values should be greater than .95 (Hu & Bentler, 1999). Method of estimation was weighted least squares with means and variance corrections (WLSMV). This procedure is appropriate for categorical/ordinal level data (Brown,

2006). Reliability was examined using ordinal alpha (Zumbo, Gadermann & Zeisser, 2007), which more accurately estimates reliability than Cronbach's alpha on ordinal measures.

Potential mediators of LH strategy

Sensation Seeking (SS): The *SS* scale includes 11 binary items measuring thrill and excitement seeking. These were taken from the 19-item Impulsive-Sensation Seeking Scale (Imp-SS; Zuckerman, Kuhlman, Joireman, Teta, & Kraft 1993) which reliably splits into distinct impulsivity and sensation seeking subscales (Copping et al., 2013b; Zuckerman & Kuhlman, 1993). The scale is summed and higher scores represent higher levels of sensation seeking. SS items include "I like to have new and exciting experiences and sensations even if they are a little frightening" and "I like doing things just for the thrill of it". CFA was used to validate the scale. The 11-item scale did not fit adequately. Removing five items created an adequate measure (df = 9, X^2 = 13.30, p > .05, RMSEA = .03, 95% CI [0.00, 0.06], CFI = .99) which was used in further analyses (α = .79). Factor loadings ranged from .29 to .64.

Impulsivity (DI): The Dysfunctional Impulsivity scale (*DI*; Dickman, 1990) is composed of 12 binary items measuring deliberative failure. The inventory is summed and higher scores represent greater impulsivity. Items include "I will often say whatever comes into my head without thinking first" and "I often get into trouble because I don't think before I act". CFA was used to validate the scale. The 12-item scale did not fit adequately. Removing four items created an adequate measure (df = 20, X^2 = 32.69, p > .01, RMSEA = .03, 95% CI [0.00, 0.05], CFI = .99) which was used in further analyses (α = .77). Factor loadings ranged from .09 to .70.

Future Orientation (FO): Future Orientation was measured using the 15-item *Future Orientation Scale* (Steinberg et al, 2009). However, two of the three subscales (*Anticipation of Future Consequences* and *Planning Ahead*) contained items that were conceptually similar to DI and these scales were moderately correlated with DI (.60 and .57 respectively). For this reason, we analysed items on the *Time Perspective* subscale only (α = .54) to maintain a clear distinction between constructs. According to Steinberg et al. (2009), the low alpha value of the subscale is attributable to the small number of items. CFA indicated a good fit to the data (df = 5, X^2 = 6.30, p >.05, RMSEA = .02, 95% CI [0.00, 0.06], CFI = .99). Factor loadings ranged from .06 to .71. This five-item measure presented two opposing statements separated by the word *BUT* on a four point Likert scale, requiring participants to indicate which statement best described them (i.e. statement A is really true for me, statement A is sort of true for me, statement B is sort of true for me, statement B is really true for me). For example, A) Some people spend very little time thinking about how things might be in the future, B) Other people spend a lot of time thinking about how things might be in the future. Higher scores represent a greater orientation towards the future.

Delay Discounting (DD): *DD* was measured using the One-Shot Delay Discounting Measure (Reimers, et al., 2009). On this binary item, participants indicated which they would prefer; £45 in three days' time or £70 in three months' time. Reimer's et al., claimed this measure to be as effective as a full behavioural DD battery. A higher score signifies preference for larger, delayed rewards.

Life-history variables

Aggression: Levels of physically aggressive behaviour were recorded using the Richardson Conflict Response Questionnaire (RCRQ; Richardson & Green, 2003). Items reference various acts of physical aggression

and respondents indicate how often they have performed each in the last year using a 5-point Likert scale labelled 'rarely' to 'often' (e.g. How many times in the last year have you kicked someone?). The six items were loaded onto one factor using CFA. Two items were dropped to produce an adequate fit (df = 2, X^2 = .43, p > .05, RMSEA = .00, 95% CI [0.00, 0.05], CFI = 1.00). Factor loadings ranged from .73 to .85. Internal consistency was high (α = .91). Higher scores index greater aggression.

Attitudes to Short-Term Relationships (STR): This was measured with an 11-item questionnaire presenting opposing statements regarding sexual and relationship behaviours. Participants indicated their response on a 4-point Likert scale in the same manner as the FO scale. This was a new measure developed for this study (see Appendix 3 for items). The 11 items were loaded onto one factor using CFA. Seven items were dropped to produce an adequate fit (df = 2, X^2 = 4.43, p > .05, RMSEA = .04, 95% CI [0.00, 0.09], CFI = .99). Factor loadings ranged from .60 to .87. Internal consistency was high (α = .81). Higher scores represent a proclivity for STR.

Puberty: Participants indicated the age at which they reached puberty from the following 11 options: Younger than 10, 10, 11, 12, 13, 14, 15, 16, 17, 18 and older than 18.

Environment

Environmental Stress: Environmental stress was examined by using perceptions of neighbourhood aggression, on the assumption that higher levels of perceived violence and victimisation are indicative of greater environmental stress (mortality risk). Levels of victimisation (*Vict*) and environmental aggression (*EA*) were measured by using modified versions of the RCRQ, which asked participants to record how often they had witnessed acts of physical aggression (e.g. How many times in the last year have you seen someone being kicked?) and how often these acts had happened to them (e.g. How many times in the last year have you been kicked?). The six victimisation items were loaded onto one factor using CFA. Two items were dropped to produce an adequate fit (df = 2, X^2 = .34, p > .05, RMSEA = .00, 95% CI [0.00, 0.04], CFI = 1.00). Factor loadings ranged from .75 to .83. Internal consistency was high (α = .89). Higher scores index more frequent victimisation. The same procedure was conducted on the witnessed aggression scale. Two items were dropped to produce an adequate fit (df = 2, X^2 = 2.93, p > .05, RMSEA = .3, 95% CI [0.00, 0.08], CFI = .99). Factor loadings ranged from .81 to .85. Internal consistency was high (α = .89). Higher scores index more frequent witnessing of aggression.

Analysis

Multi-group analysis was used to examine structural invariance on all of the above measures as a function of sex and heterogeneity of participant age (categorised as age 13-17 (N=584) and 18+ (N=157[18]). All measures demonstrated structural invariance across age and sex (model statistics available on request). Analyses were conducted using IBM SPSS (V20) and R (V3.1).

[18] Only two categories were used due to low n for age groups higher than age 21. Low samples would make CFA analyses impossible.

Results

The following analyses are exploratory and do not permit conclusions about causal relationships between personality variables and LH variables. Descriptive statistics are given in Table 31. Correlations are provided in Table 32.

"Time preference" as a unitary construct

Table 32 shows that all four potential traits are related to each other (albeit, weakly). This may therefore support the contention that "time preference" is a global trait. CFA was used to examine whether such a higher-order structure fit the data. All four indicators were loaded onto a single, higher-order latent factor (representing "time preference"). WLSMV was used to calculate the fit to the data set. This procedure yielded a model that did not adequately fit the data (df = 167, X^2 = 321.75, p < .001, RMSEA = .04, 95% CI [0.03, 0.04], CFI = .94), with a significant X^2 and a CFI less than .95. Testing for structural invariance between sex and age groups showed that the higher-order structure also varied between groups. Fitting the model to males and females separately yielded a X^2 difference of 92.76 (p <.001). The female model did not adequately fit the data (df = 167, X^2 = 285.46, p < .001, RMSEA = .04, 95% CI [0.03, 0.05], CFI = .93). The male model was a closer fit to the data although X^2 was still significant (df = 167, X^2 = 192.70, p < .01, RMSEA = .02, 95% CI [0.00, 0.04], CFI = .97). The same procedure was repeated across the two age categories, yielding similar (albeit, less variant) figures, with a X^2 difference of 53.21 (p<.001), with a less adequate model for older participants (df = 167, X^2 = 202.34, p < .001, RMSEA = .04, 95% CI [0.01, 0.05], CFI = .93) than for younger participants (df = 167, X^2 = 255.55, p < .001, RMSEA = .03, 95% CI [0.02, 0.04], CFI = .94). The construct of "time preference" appears to be neither a viable higher-order construct nor invariant across sex and age. Appendix 4 shows the factor loadings across each group.

Table 31: Descriptive Statistics for all study variables

	Minimum	Maximum	Mean	SD
Age	13.00	69.00	16.87	5.59
Puberty	9.00	18.00	11.79	1.45
Impulsivity (DI)	0.00	8.00	3.38	2.27
Future Orientation (FO)	0.00	3.00	1.63	.56
Sensation Seeking (SS)	0.00	6.00	3.76	1.76
Delay Discounting (DD)	0.00	1.00	.54	.50
STR	0.00	12.00	4.23	3.09
Aggression	0.00	16.00	4.03	4.30
Victimisation	0.00	16.00	3.44	3.84
Environmental Aggression	0.00	16.00	5.70	4.40

Criterion Evaluation

Table 32 presents correlations between study variables. All candidate variables were associated with the life-history variables in expected directions (Criterion 1). Aggression and orientation to short-term relationships increased with higher levels of DI and SS, weaker FO and a preference for immediate rewards. All correlations were significant (p <.05) albeit weak to modest in strength (ranging from r = -.11 to .37). *DI* and *SS* had the strongest associations with life-history variables

Criterion 2 was that candidate variables should correlate with pubertal onset. SS and DI were the more strongly associated (r = -.15 and -.10, p < .01), whilst DD and FO showed weaker correlations (r =.09 and .08, p<.05). Higher scores on SS and DI were associated with lower age at puberty. Pubertal onset was later for those with a stronger FO and the propensity to discount short-term rewards.

Criterion 3 proposed that candidate traits should be associated with levels of environmental stress, indexed by exposure to and witnessing of violence. Table 32 shows that all four variables were associated with victimisation and witnessing aggression (p < .05).

Criterion 4 focussed on sex differences in candidate variables. Independent samples t-tests were conducted on each personality trait (chi-square was conducted on DD due to its binary nature). Table 33 presents the results. Significant differences were found in all variables in the expected directions (p < .05). Males scored higher on DI and SS, were less future orientated and less likely to defer rewards. Males were also more aggressive and more orientated towards short-term sexual relationships (p < .05 in both cases).

To assess relative relationship strengths, regression analysis was used to examine the variance contributed by each trait to each LH variable (Table 34). Using forced entry method, regression allows us to examine the unique variance associated with each predictor. Based on these analyses, *SS* was the only variable to show consistently significant relationships across all variables (p < .01 in all cases). *DI* was significant with all variables except *Puberty* and showed stronger links to aggression (exposure to and use of) than SS. *FO* and *DD* showed the least consistent patterns of relationships across LH variables.

Discussion

The aims of this study were twofold: to evaluate the global construct of "time preference" and to evaluate potential candidate mechanisms in terms of their suitability as mediating mechanisms in life-history models. The results indicated that a higher-order global construct of time preference did not fit the data. Supporting previous work (Frederick et al., 2002; Wilson and Daly, 2006), lack of statistical parsimony on the full sample and lack of structural invariance across sex and age, as well as weak correlations between components cast doubt over its feasibility. As all latent measurement structures (see Method) used in this analysis demonstrated invariance across age and sex, the fact that a combined structure did not demonstrate invariance suggests that these traits do not work in the same way together across different sex and age groups. Whilst there was clearly shared variance between the four personality traits, it was not sufficient to support the notion of "time preference" (or indeed "impulsivity") as coherent umbrella constructs in their own right. This is congruent with a growing body of work into the

Table 32: Table of Correlations

	STR	Aggression	Puberty	Victimisation	Environmental Aggression	Future Orientation	Sensation Seeking	Delay Discounting
Impulsivity (DI)	.22**	.37**	-.10**	.34**	.31**	-.31**	.33**	-.24**
Future Orientation (FO)	-.20**	-.12**	.08*	-.09*	-.09*		-.24**	.17**
Sensation Seeking (SS)	.21**	.32**	-.15**	.27**	.24**			-.14**
Delay Discounting (DD)	-.11**	-.19**	.09*	-.18**	-.20**			

*p<.05, **p<.01

Table 33: Significance tests for sex differences (DF = 739)

	Mean (M)	SD (M)	Mean (F)	SD (F)	t/X^2	p	*d*
Impulsivity (DI)	3.62	2.18	3.23	2.31	2.39	*	0.17
Future Orientation (FO)	1.51	.54	1.72	.55	-5.02	**	0.38
Sensation Seeking (SS)	3.97	1.65	3.62	1.81	2.81	**	0.20
Delay Discounting$^{\pi}$ (DD)	.48	.50	.58	.49	9.82	*	0.17
Aggression	4.60	4.40	3.62	4.19	3.08	**	0.23
STR	4.86	3.40	3.79	2.78	4.68	**	0.29
Pubertal Onset	11.56	1.39	11.94	1.47	-.38	**	0.13

*p<.05, **p<.01, π reported as a Chi Square with a DF of 2

Table 34: Significance of Standardized Beta Weights in Regression Analysis

	Aggression	STR	Puberty	Victimisation	Environmental Aggression
Impulsivity (DI)	0.28**	0.13**	-0.04	0.28**	0.24**
Future Orientation (FO)	0.03	-0.17**	0.03	0.05	0.04
Sensation Seeking (SS)	0.22**	0.14**	-0.12**	0.17**	0.15**
Delay Discounting (DD)	-0.10**	-0.04	0.06	-0.10*	-0.13*

*p<.05, **p<.01

multidimensional nature of superficially similar personality traits (Depue and Collins, 1999; Teuscher and Mitchell, 2011; Wilson and Daly, 2006). However it should be noted that sample sizes between the age and sex groups differed in the present data and this could have potentially inflated X^2 values (Brown, 2006). More balanced samples may have yielded a more invariant higher-order construct; Further research is required to examine this possibility.

Regarding the second objective, correlation analysis suggests all of the potential psychological mediating mechanisms in this study demonstrated; 1) relationships with aggression and mating attitudes in expected directions; 2) significant sex differences consistent with evolutionary theory; 3) significant associations with environmental stress (victimisation and witnessing aggression) and; 4) significant associations with pubertal onset. Impulsivity and sensation seeking appeared to be the most successful traits with regards to these four criteria, with future orientation and delay discounting being less strongly related.

Regression analyses confirmed this pattern of results, with impulsivity and sensation seeking yielding the highest beta weights for the prediction of pubertal onset, aggression, mating orientation and levels of environmental aggression and victimisation. Sensation seeking however was the only variable to be significant in all cases. It therefore seems likely that sensation seeking is the best of the current candidates to represent the mediating mechanism between environmental stress and life-history strategy. It should be noted however that impulsivity, whilst not related to puberty, appeared to be more strongly associated with aggression and environmental aggression. Delay discounting and future orientation were the weaker predictors and this analysis suggested that they are more peripherally related to life-history variables.

Specifically why sensation seeking and impulsivity appear to be more closely related to life history variables than future orientation and delay discounting is beyond the scope of this study. Future orientation and delay discounting may involve more situational and reflective cognitive abilities, while sensation seeking and impulsivity may capture more enduring affective and temperamental traits (MacDonald, 2008). Future work however is needed to fully explain these results fully.

Limitations, future work and conclusions

In any study, conclusions are specific to the measurement instruments used. Our measures of stress do not readily encapsulate the complexity of (and interactions between) harshness and unpredictability in environments (Ellis et al., 2009). Furthermore, our focus was explicitly on external sources of stress as hypothesised by Chisholm (1999). Recent theoretical work by Nettle, Frankenhuis and Rickard (2013) has suggested a potential role for internal sources of mortality (e.g. pathogenesis, somatic damage) as a driver of strategy behaviour. Such factors were not measured here but should not be ignored in future work. Future work

should also consider if low or absent correlations are as a result of potential suppressor variable(s) which may impact upon life history strategy.

Our index of mating orientation was designed specifically for this study, whilst measures of environmental stress (witnessed aggression and victimisation) were modifications of an existing self-report measure of aggression (the RCRQ – Richardson and Green, 2003). Whilst appearing to represent the intended constructs, these require further testing for the purposes of establishing reliability and validity.

Measures were selected for brevity and simplicity for the purposes of this school-based research. Whilst this aids recruitment and prevents loss of attention, other longer, validated measures could be implemented, such as the SSS-V (Zuckerman, 1994), the Barrett Impulsivity Scale (Patton, Stanford and Barratt, 1995) a full delay discounting task and the Zimbardo Time Perspective Inventory (Zimbardo and Boyd, 1999). The one-shot delay discounting measure, whilst quick and easy to administer is known to produce only small, negative correlations with age of first sex and income in large samples (Reimers, 2009). Furthermore, single item measures of discounting have been shown to have stronger associations with personality traits, including impulsivity and sensation seeking, than with a full delay discounting battery (Mishra and Lalumière, 2011). These differential associations may have implications for tests of global "time preference" measures. Future studies should employ alternative indices in order to determine the replicability of the present findings.

Future work needs to establish how potential candidate mechanisms (such as sensation seeking and impulsivity in particular given the present results) develop during childhood, as well as the environmental inputs to which they are sensitive and the life-history variables which they affect. Longitudinal data and multivariate modelling are required to properly examine personality mediators of strategy development as part of a longitudinal trajectory. Previous studies have attempted to show how time preference may work in a life-history context (Hill et al., 2008), but the conceptually inconsistent use of "impulsivity" still makes it difficult to ascertain the precise mechanisms involved in strategy development. Longitudinal designs eliminate the need for less reliable retrospective measures of development, particularly self-reported assessments of pubertal timing where the signs are less memorable and distinct for males than for females. Future studies need a more accurate way of gauging pubertal onset given its theoretical importance as a developmental switching point.

The results of this study did not contradict the fundamental premise of Chisholm's (1999a) proposal. Our aim was to clarify the conceptual basis of the 'time preference' that he invokes. Our exploratory analysis suggests that, although the four potential candidates were weakly correlated, a unitary "time preference" structure did not emerge. We suggest that measures of sensation seeking and impulsivity appear to be better candidates for time preference than constructs such as discounting or future orientation. We hope that these findings stimulate further work in this field

4.2. Conclusions regarding Time Preference

Papers Four, Five and Six provided much needed information in refining the concept of "time preference", as well as highlighting some useful areas for future research. The findings are very briefly summarised here.

First, like many life history behaviours (aggression and reproductive behaviours in particular), the meta-analysis showed that there are sex differences in various "impulsivity" traits. In particular, behaviours representing attraction towards reward (such as sensation seeking) showed the strongest sex differences, with less affective aspects of impulsivity showing smaller and less consistent differences.

Second, sensation seeking appears to be the trait that is consistently linked with reproductive behaviour, sexual attitudes, aggressive behaviour and indices of environmental stress. Impulsivity (as deliberative failure) was less strongly associated these variables and showed some inconsistencies between Papers Five and Six, particularly in relation to its association with pubertal onset and its contribution of additional variance when modelled alongside sensation seeking. These inconsistencies may have resulted from differences in the measurement inventories used (the impulsivity scale from the Impulsive-Sensation Seeking Scale in Paper Five and the Dysfunctional Impulsivity Scale in Paper Six). Age effects may also have been an issue as the sample in Paper Five was significantly older than the sample in Paper Six (39.21 years and 16.87 years respectively). Research shows that impulsivity is higher in developing individuals and steadily declines from around age ten (Galvan, Hare, Voss, Glover & Casey, 2007; Leshem & Glicksohn, 2007; Steinberg, Albert, Cauffman, Banich, Graham & Woolard, 2008). Delay discounting and future orientation showed much greater variability in their relationship to key life history variables and so will not be included in the final study.

Third, "time preference", like impulsivity, is not a unitary construct. The evidence suggests that traits that have been taken to be proxies for "time preference" differ significantly in their relation to each other, their effects on behavioural outcomes and their sensitivities to environmental stressors. A higher-order construct is therefore not tenable, supporting previous research in the field (Frederick, Loewenstein and O'Donoghue, 2002; Wilson and Daly, 2006).

As sensation seeking is the most obvious candidate to represent "time preference", this variable was used in the next study to determine how it interacted with environmental stressors and behavioural outcomes in the context of a full structural model. By specifying such a model, this study examines whether sensation seeking may be a potential mediator between key stressors (including family instability), and life history outcome variables such as aggression, pubertal onset and sexual attitudes (as envisioned by Chisholm). The results from this present chapter however show that dysfunctional impulsivity also demonstrates most of the relationships expected from a trait variable proposed to mediate the effects of environmental stress, albeit to a lesser extent. For this reason, dysfunctional impulsivity was also included in the full model, allowing simultaneous examination of the two candidate mechanisms.

CHAPTER FIVE

Modelling Psychosocial Acceleration Theory

5.1. Introduction

This chapter brings together aspects of psychosocial acceleration theory reported in earlier chapters. Here the interrelated processes hypothesised by Belsky et al. (1991), Chisholm (1993; 1999a) and Del Giudice (2009a) are examined together to produce a measureable model of behavioural outcomes. Using the conclusions from the earlier environmental studies reported in Chapter Three and the refinements made to the concept of time preference in Chapter Four, an attempt to create as comprehensive a model of psychosocial acceleration theory as possible is made to determine if important relationships (often specified independently or in small clusters in previous work) are evident when examined simultaneously in a single model. Sex differences in strategy development are also considered. Whereas in the previous studies, the focus has been on aggression and sexual attitudes/behaviours as outcomes, pubertal onset is also now introduced, thus testing a core prediction of the Belsky et al. model (1991).

Few studies to date have tested such a comprehensive model which is perhaps not surprising given the size and scope of the theoretical proposals. The fact that psychosocial acceleration theory is also a developmental theory creates added methodological and interpretative demands that would require longitudinal studies to properly resolve. Nevertheless, there have been some detailed cross-sectional and longitudinal tests of psychosocial acceleration theory that have led to important insights. Hill et al. (2008) used a small sample of college students to show that family environments, biological factors, and exposure to violence predicted "time preference" which in turn predicted impulsivity and risk taking. Kruger et al. (2008) showed that time perspective mediated the effect of the socio-developmental environment on strategy behaviour (aggression and crime) in a cross-sectional sample of 12 to 14 year-old pupils. Similarly, Schecter et al. (2010) showed expected patterns of correlations between time perspective, life expectancy, attachment and risk taking on a cross-sectional sample of 10-19 year olds. In a series of experiments on college students, Griskevicius, Delton, Robertson and Tybur (2011) substantiated a series of proposed links between mortality and risk-taking behaviour. Several longitudinal studies have attempted to model the process in a way that more validly captured the temporal order of effects. Belsky et al. (2012) showed that greater environmental harshness and unpredictability predicted lower maternal sensitivity and increased sexual activity in a large U.S sample of children. Similarly, Brumbach et al. (2009) found that harshness and unpredictability increased, sexual unrestrictedness and social deviance in adolescence and early adulthood. Other longitudinal studies have demonstrated similar results (James et al., 2012; Simpson et al., 2012). All these studies provide valuable support for the general principles of psychosocial acceleration theory, but no study (to the author's knowledge) has tested so many of the key proposals in one model. Paper Seven was an attempt to fill this void in the literature.

In the study reported in this chapter, a cross-sectional sample of school and college pupils aged 13 to 18 years of age was used. This study parallels that of Hill et al. (2008) with an expanded number of theoretically-derived variables and a specification of temporal ordering that is more congruent with current thinking in life history research. These pupils had reached adolescence and thus can be expected to have adopted

a life history tempo conditioned to their local ecological niche. This study therefore looked at a time point near the end of strategy development and near the onset of reproduction. This had some limitations (which are discussed in Paper Seven and in Chapter Six). This study was, at best, foundational and aimed only to determine if the whole model (as opposed to various individual parts) worked in unison. Whilst the results were encouraging and the outcomes in line with the theoretical position of this thesis, more sophisticated studies are needed to establish the causal (or at least temporal) elements of this theory. Cross-sectional correlations do not amount to a test of causality, however they are modelled.

Paper Seven is immediately followed by a reanalysis of the same data set by sex. As emphasised throughout, sex differences in strategy determination are expected theoretically, are consistent with the evolutionary developmental literature (see Del Giudice, 2009a for a comprehensive review) and have been demonstrated empirically (James, Ellis, Schlomer and Garber, 2012). For this reason, the final model of life history strategy development is re-examined by sex of respondent in order to identify potential differences in environmental sensitivities, psychological mediators and outcome behaviours. The key findings and implications of this analysis are discussed in detail and are developed further in the final chapter.

Environmental Stress and Life History Strategy: What are the Psychological Mediators?

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Developmental Psychology (Under Review)

Abstract

Building upon previous work in developmental psychology and behavioural ecology, this study aimed to test the principle tenets of psychosocial acceleration theory (Belsky, Steinberg & Draper, 1991; Chisholm, 1993). Using a sample of English adolescents (N=563), structural equation modelling was used to determine if environmental factors, family instability and time preference predicted age of puberty, levels of direct aggression and short-term mating orientation. Results demonstrated that levels of aggression in the environment, population density, life expectancy, negative sex ratios and family instability were related to time preference (represented by impulsivity and sensation seeking) which in turn predicted pubertal onset, aggression and mating orientation. Environmental variables also had a direct effect on aggression and mating orientation, as well as operating through personality variables and family instability. Results are discussed from a life history perspective and it is concluded that the core principles of psychosocial acceleration theory are supported.

Keywords: evolutionary developmental psychology, life history theory, psychosocial acceleration theory, aggression, puberty

Introduction

Significant developments in evolutionary psychology and behavioural ecology have furthered our understanding of the developmental trajectories of individuals. Research has long documented the positive relationship between increased aggressive tendencies, heightened sexual activity and precocious development in some adolescents (Celio, Karnik & Steiner, 2006; Woodward & Fergusson, 1999; Xie, Cairns & Cairns, 2001). This study aimed to examine how these trajectories may emerge and how they represent adaptive behavioural solutions attuned to different environmental challenges, with an approach that synthesizes developmental and evolutionary perspectives.

Evolution and child development

Evolutionary science and child development are not incompatible. Developmental psychologists have long emphasized that the environment is crucial in shaping a child's developmental trajectory. Theorists have argued that the child's environment constitutes a multi-faceted web of proximal, distal, social and biological influences that interact to shape development (Brofenbrenner, 1979). Developmental models show that the

presence of disruption and stress during childhood can cumulatively compromise development and result in socially disadvantageous outcomes (Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987; Scaramella, Conger, Simons, & Whitbeck, 1998; Seifer et al, 1996). Whilst developmental models have been useful in identifying sources of cumulative risk, evolutionary approaches offer the prospect of a unifying model of child development. Evolution has shaped human behaviour to be adaptive: to propagate an individual's genetic lineage into future generations. The brain has evolved over thousands of generations to solve problems posed by the environment. As such, the brain demonstrates considerable plasticity, shaping behaviour adaptively to the ecological niche in which an individual develops. Where developmentalists talk of stress-induced developmental disruption and socially pathological outcomes, evolutionists propose that stress guides and adjusts trajectory to facilitate adaptive outcomes suited to the conditions imposed by that environment. This perspective on development has emerged through integrating the principles of life history theory and human behavioural ecology with developmental psychology.

Life history theory

Life history theory is an explanatory framework describing emerging and varying phenotypes within and between species (Roff, 1992; Stearns, 1992). Organisms invest time and resources in various traits during development. However, resources are finite, ensuring trade-offs between traits to optimize (although not necessarily maximize) fitness returns, with constraining effects on development. Perhaps the most important trade-off is the switch between somatic development and reproductive effort (Charnov, 1993; Stearns, 1992), which Schaffer (1983) terms the 'general life history problem'. Reproduction can be delayed to foster somatic growth but this reduces the window of future reproduction. Alternatively, somatic growth can be halted in favor of reproducing in the present at the potential expense of offspring quality. Reproductive timing is therefore tailored to environmental circumstances and successful individuals (i.e. those that reproduce) optimize this switch point. Those favoring somatic growth adopt a 'slow' strategy, favoring older ages of reproduction, fewer children and greater offspring investment. Those favoring reproduction adopt a 'fast' strategy, reaching puberty early, reproducing quickly and frequently without investing greatly in each offspring. It should be emphasized that this is not a dichotomy, but a continuum resulting from the differential allocation of resources.

Life history and child socialization

Early research noted the pivotal role of father absence in the acceleration of puberty in girls (Draper & Harpending, 1988). Belsky, Steinberg and Draper (1991), developed this idea into a complete evolutionary-developmental hypothesis of child socialization. In this model of developmental trajectories (often referred to as Psychosocial Acceleration Theory), stress in the environment is the ultimate cause of differential resource allocations. High levels of stress disrupt attachment bonds (Bowlby, 1969) between parents and developing children, cueing children to a harsh and unpredictable future. Father absence is one such stressor. Father-absent homes force mothers to spread fewer resources more thinly, resulting in stress and anxiety that reduces the quality of attachment bonding with offspring. Children developing under stressful conditions grow up with the expectation that stable resource provisioning will not be forthcoming and embark upon a trajectory calibrated to ameliorate the effects of lower resources and greater familial instability (such as frequent movement or multiple

new step-parents entering the home). This strategy often manifests in a suite of changes including earlier pubertal onset, earlier reproduction, a greater proclivity for short-term mating over long-term pair bonds and a propensity for heightened aggression, a mechanism that can be used to appropriate resources when other strategies fail. Belsky et al., (1991) argued that this developmental system promoted reproductive fitness in the environmental niche of the individual (although it is important to emphasize that this does not necessarily promote psychological wellbeing and adjustment). Where the Psychosocial Acceleration model differed from traditional developmental approaches was in its focus on pubertal timing as a key switching point, affected by the socio-developmental context of child rearing and ultimately impacting on future outcomes (such as aggression and promiscuity). Indeed, much evidence has accumulated over the past twenty years to support this model of development. Research has shown that greater parent-child warmth and attachment security longitudinally predict later pubertal onset, whereas child-parent conflict and father absence are associated with earlier puberty (Ellis, 2004; Ellis, McFayden-Ketchum, Dodge, Petit & Bates, 1999; Moffitt, Caspi, Belsky & Silva, 1992). Similarly, research on the impact of environmental stress on life history strategy is also compelling (Belsky, Schlomer & Ellis, 2012; Brumbach, Figueredo & Ellis, 2009; Chisholm, 1999b; Chisholm, Quinlivan, Peterson & Coall, 2005; James, Ellis, Schlomer and Garber, 2012; Simpson, Griskevicius, I-Chun Kuo, Sung & Collins, 2012).

Chisholm (1993) extended psychosocial acceleration theory. To Chisholm, the stress induced by the environment and transmitted through the attachment bond did not just convey information about levels of resource uncertainty, but afforded an insight (consciously or otherwise) into expected lifespan. Mortality risk is an important consideration in relation to reproductive timing and life history strategy. Across species theorists have proposed that age-specific mortality rates are crucial determinants of reproductive onset: those with shorter lifespans are predicted to adopt faster strategies (Charnov & Berrigan 1990; Promislow & Harvey, 1990; Stearns 1991). Delaying puberty runs the risk of reproductive failure in the event of premature death. Reproducing too early however may disadvantage offspring if resources have not been accrued to enable effective rearing. This link between mortality and reproductive schedules was therefore a crucial addition to the theory. Individuals who cannot expect a long life would be expected to bring forward their reproductive schedule in order to ensure fitness returns by reaching puberty earlier; being more sexually precocious, active and risky; and reproducing earlier and more frequently. Current research demonstrates a clear link between mortality and early reproduction (Burton, 1990; Copping, Campbell & Muncer, 2013a; DuRant, Cadenhead, Pendergrast, Slavens & Linder, 1994; Geronimus, 1996; Johns, 2011; Nettle, 2010; Wilson & Daly, 1997).

Chisholm (1999a) made a further theoretical contribution. Whilst Belsky et al. (1991) focused predominantly on ultimate causal factors that impacted upon pubertal onset, Chisholm introduced a psychological mechanism that mediated functional adaptive decision making: time preference. Time preference is an economic term synonymous with "intertemporal choice [between alternatives with varying costs or benefits over time], impatience, impulsiveness, self-control and the inability to defer gratification" (Chisholm, 1999a, p.135). Individuals who developed under a climate of stress and uncertainty generate an impression (not necessarily consciously) that life will be short. Consequently, such individuals devalue the future for fear of not having one. The heightened salience of rewards in the present increases and shortens an individual's time

preference, making earlier reproduction, short term mating and aggressive behaviour more attractive options that may improve resource access and ultimately, genetic propagation. Whilst many psychological perspectives would view this behaviour as pathological, this response to uncertainty can be viewed as adaptive and indeed rational when the future cannot be predicted (Chisholm, 1999a; Gardner, 1993). Research supports the proposal that devaluing the future supports 'faster' strategies and increases proclivity towards aggressive and criminal activity (Hill, Jenkins & Farmer, 2008; Kruger, Reischl & Zimmerman, 2008; Schechter & Francis, 2010; Wilson & Herrnstein, 1985).

Whilst evidence for psychosocial acceleration theory has accumulated since its original incarnation, few studies attempt to examine the full model in its entirety. This study attempts to fill this gap. We first review some of the core concepts in greater depth.

The environment

How should "stress" be conceptualized? Early works were not specific in their description of general environmental 'uncertainty'. Chisholm claimed that "ultimately, universal sources of parental stress are the routine social and environmental causes and correlates of high mortality rates—poverty, exploitation, hunger, disease, and war and their accompanying fear and hopelessness" (Chisholm 1993:7). Whilst these factors are doubtless important, many are rare in western society, begging consideration of other sources of stress that may contribute to strategy development.

Ellis, Figueredo, Brumbach & Schlomer, (2009) identify possible factors such as socioeconomic deprivation, victimization, poor health, low mortality and neighborhood deterioration. Indeed, studies from a number of disciplines identify a multitude of specific ecological stress factors. Few however examine these factors simultaneously. This is important as Ellis et al. (2009: 254), note: "various moderating conditions, operate in an interrelated manner—meaning that just knowing one of these environmental dimensions does not afford accurate prediction of evolution or development." Recently Copping, Campbell & Muncer (2014a; under review) examined previously identified environmental risk factors at both societal and individual level, linking these to local rates of aggression and sexual precocity. They concluded that "Environments characterized by low life expectancies, poor educational prospects, rising unemployment, high levels of lone parenting, low youth sex ratios and dense populations are conducive to increasing rates of violence and sexually precocious activity" (Copping et al., 2013:149). We will briefly review the importance of these factors.

Socioeconomic status and inequalities, representing modern resource scarcity, have long been linked to fast strategy behaviours, including aggression and teenage pregnancy (Coulton, Korbin, Sue and Chow, 1995; Wilkinson & Pickett, 2009). Low levels of education reflect poor future opportunities, decreased social mobility and low resource access, making aggression and sexual precocity more attractive (Dobrin, Lee & Price, 2005; Limbos & Casteel, 2008). Low life expectancy (indexing mortality risk) is also important in guiding strategy trajectories (Chisholm, 1993; Wilson & Daly, 1997), with lower life expectancies encouraging individuals to adopt faster strategies. Sex ratios appear to play a critical role: areas where females outnumber males (who are thereby freer to pursue strategies prioritizing mating over parenting) are more likely to be characterized by family breakdown, female lone parenting, aggression and sexually precocious behaviour (Barber, 2000a; 2000b;

Guttentag & Secord, 1983). Population density (particularly youth density) also fosters strategy-related behaviours, particularly aggression (Land et al, 1990). High densities increase resource scarcity, and conspecific violence becomes more prevalent through increased likelihood of hostile encounters. Copping et al. (2013a), using census data, found all of these factors to be highly interrelated. A further study (Copping et al. 2014a, under review) reported a similar pattern of relationships at the individual level of analysis. Doubtless, there are additional factors that impact upon strategy development. Our point supports that of Ellis et al., that characterization of ecologies must consider as many interrelated factors as possible in relation to the development of life history strategies.

Time preference

What specifically is "time preference"? Chisholm's concept is frequently invoked in life history studies. Research indicates that those who devalue the future demonstrate patterns of behaviour consistent with faster life history strategies (Chisholm, 1999b; Kruger et al., 2008; Schecter & Francis, 2010; Wilson & Hirnstein, 1985). There is debate however over the viability of the time preference construct, particularly because lower-order traits subsumed by this construct are themselves heterogeneous clusters (such as impulsivity; Cross, Copping & Campbell, 2011; Depue and Collins, 1999; Evenden, 1999) and a unidimensional trait of time preference is unlikely to exist (Copping, Campbell & Muncer, 2013b; Copping, Campbell & Muncer, Under Review b; Frederick, Loewenstein and O'Donoghue, 2002; Loewenstein, Weber, Flory, Manuck and Muldoon, 2001; Teuscher & Mitchell, 2011). Nevertheless, the importance of a psychological mediator cannot be understated. Whilst "time preference" remains the dominant proposal for the construct that mediates the relationship between stress and strategy, other proposals have been made. Ross and Hill proposed that individuals form an "unpredictability schema", representing "a pervasive belief that people are unpredictable and the world is chaotic" (2002: 458) driving individuals to adapt by focusing on present orientated consumption. Similarly, Daly and Wilson (1997) suggested that environmental data form statistical composites within the psyche representing the immediate ecology which in turn influence reproductive and competitive behaviours. Whilst the nature of the psychological mediator is debatable, empirical work supporting these latter conceptualizations is currently lacking.

The regulation of socio-affective responses may be particularly important to strategy development and may act as a potential psychological mediator. Dual process models of impulse versus constraint (see Carver 2005, for a review) suggest that at the lowest level, engagement in behaviour is regulated by two systems: the behavioural approach system (BAS) and the behavioural inhibition system (BIS) (Gray 1972, 1994). BAS regulates sensitivity to reward: governed by the dopaminergic system (Zuckerman & Kuhlman, 2000). BIS responds to threatening stimuli and is thus punishment sensitive. The competing actions of these two systems regulate approach/avoidance activities. Research suggests that these systems are modulated by an additional system: effortful control is a higher order mechanism that inhibits prepotent responses (Eisenberg et al., 2004; MacDonald, 2008). Copping et al., (2013b) reported that, in an adult sample, sensation seeking (representing lower-order BAS-based traits) subsumed the predictive variance of impulsivity (deliberative failure, representing a failure of effortful control) in a structural model predicting short-term sexual behaviours. Copping et al. (2014b, under review) examined four traits that potentially represent time preference: sensation

seeking (BAS), deliberative failure (effortful control), time perspective (higher order planning and executive functioning) and delay discounting (which is cognitively ambiguous). Only sensation seeking emerged as consistently related to environmental stress, pubertal onset, mating orientation and aggression, whilst deliberative failure was significantly related to all measures except pubertal onset. Sensation seeking and deliberative failure may therefore be two important constructs that mediate strategy trajectories, representing respectively attraction to and inhibition of reward-based behaviour. Furthermore, Copping et al. concluded that these two mechanisms, whilst correlated, had independent effects and that no global construct of 'time preference' was evident.

Current study

This study aimed to examine psychosocial acceleration theory as comprehensively as possible. Structural equation modelling was used to examine the impact of the perceived environment and time preference on pubertal onset, aggression and orientation to short and long term mating. Based on theory and previous work, we expected impulsivity and sensation seeking to play a mediating role between the family environment and strategy-related behaviours. We also predicted that the environmental antecedents should have effects at various levels, both indirect (through family instability) and direct (on individual behaviours). Few studies have examined multiple outcomes simultaneously within the same study (e.g. Copping et al., 2013a, under review; Nettle, 2010; Simpson et al., 2012) highlighting the need for more comprehensive models. Both environments and strategies are complex, multifaceted concepts. Whilst examining specific behaviours in relation to ecological factors is important, examining a suite of behaviours theoretically associated with strategy is particularly informative for theory development.

Method

Participants

Adolescents (N = 563, 253 male) between the ages of 13 and 18 were recruited from schools in the North East of England. Data were collected using an online questionnaire measuring variables of interest. No exclusion criteria were implemented except that participants had to be at least age 13 (for ethical reasons). The mean age for males was 14.63 (SD = 1.32) and for females 15.15 (SD = 1.63).

Measures

Validation of the measures described below was tested using confirmatory factor analysis (CFA) and evaluated against fit criteria. Significant X^2 values highlight differences between the model and data matrices. Significant values are more likely in large samples with strong intercorrelations (Kline, 2005) and so require scrutiny alongside other indices. CFI (Comparative Fit Index) should be above .90, indicating similarities between the covariance and data matrices (Loehlin, 2004). The RMSEA (Root Mean Square Error of Approximation) examines model complexity and should ideally be lower than .10 (Bentler & Bonnet, 1980). All analyses were conducted using IBM's SPSS and AMOS software (Version 20). The following independent variables (representing environmental stress) were measured:

Youth Density: Participants indicated on a four point Likert scale if individuals in their neighborhood were predominantly young or old. Higher scores indicate neighborhoods biased towards a greater predominance of youths.

Population Density: Participants indicated on a four point Likert scale how crowded they felt their neighborhood was, with higher scores representing higher densities.

Youth Sex Ratio: Participants indicated on a four point Likert scale if they noticed a bias towards one particular sex. Higher scores represent environments with more females.

Family Instability: Participants completed a 15-item questionnaire (using a four point Likert scale on each item) assessing four domains: parental discipline (consistency of disciplinary actions by parents, N = 3, α = .62), family mobility (frequency of movement to different jobs, schools, homes and the movement of new individuals in and out of the family unit, N = 4 α = .69), meal provisioning (examining healthiness, consistency and availability of meals, N= 4 α = .68) and attachments (examining time spent with and closeness to parents, N = 4 α = .83). CFA demonstrated that all scales were acceptable fits to the data (X^2 >.01, CFI >.96, RMSEA <.10 in all cases) despite the lower than desired alpha values. All four were treated as latent variables and loaded onto a single higher order factor for the purposes of modelling. CFA confirmed an adequate fit to the data (X^2 <.01, CFA = .93, RMSEA = .06) despite a significant X^2 value. Items can be viewed in Appendix 5.

Life Expectancy: Life expectancy was used to represent perceived mortality risk. Participants estimated the age (in years) to which they expected to live. To prevent extreme values distorting results, values greater than 90 were capped at that level.

Victimization: Participants completed a modified version of the Richardson Conflict Response Questionnaire (RCRQ; Richardson & Green, 2003) to report direct aggressive acts they had experienced in the past year using a five point Likert scale. Higher scores represent greater victimization. The validity of the construct was established using CFA. Five items best represented the construct of victimization (α = .90, X^2 >.05, CFI .99, RMSEA, .04).

Witnessed Aggression: Participants completed a modified version of the RCRQ to report direct aggressive acts they had witnessed in the past year using a 5 point Likert scale. Higher scores represent higher incidences of neighborhood aggression. Four items from the measure best represented the construct of victimization (α = .93, X^2 >.05, CFI .99, RMSEA, .00).

The following dependent and mediating variables were measured:

Aggression: Participants completed the RCRQ to assess the frequency of direct aggressive acts they had engaged in over the past year using a five point Likert scale. Higher scores represent more frequent aggressive behaviours. Five items from the RCRQ best represented the construct of aggression (α = .90, X^2 >.05, CFI .99, RMSEA, .00).

Attitude to Mating: It was ethically inappropriate to measure sexual experiences directly due to the age group of participants. Instead, attitudes towards sex and relationships were examined. Participants rated agreement on items assessing attitudes to casual sex, and to long and short-term relationships using a four point Likert scale. Higher scores represent attitudes favoring short-term relationships. A five item scale provided a reliable measure with a good fit to the data set ($\alpha = .79$, $X^2 > .05$, CFI .99, RMSEA .02).

Pubertal Onset: Participants were asked to indicate at what age (in years) they had reached puberty.

Sensation Seeking: Sensation Seeking was measured using 11 binary items from the Impulsive Sensation Seeking Scale (Zuckerman, Kuhlman, Joireman, Teta, & Kraft 1993). CFA (using ASDF estimation due to its binary nature) reduced this measure to five items ($\alpha = .65$, $X^2 > .01$, CFI .94, RMSEA .06). For the purposes of SEM and to make it consistent with other variables, Sensation Seeking is treated as an observed variable, using the summed total score.

Impulsivity: Impulsivity was measured using the Dysfunctional Impulsivity Scale (Dickman, 1990) which is defined as "The tendency to act with less forethought than most people of equal ability when this tendency is a source of difficulty". Participants indicated their agreement with 12 binary items. CFA (using ASDF estimation due to its binary nature) reduced this measure to five items ($\alpha = .67$, $X^2 > .05$, CFI .99, RMSEA .02). As with Sensation Seeking, impulsivity is treated as an observed variable, using the summed total score.

Results

Table 35 shows descriptive statistics for each measured variable. Table 36 shows correlations between all variables. Two of the dependent variables, aggression and orientation to short-term mating, were positively correlated (r=.31) and both were positively associated with levels of family instability (r=.36/r=.48 respectively), impulsivity (r=.33/r=.24) and sensation seeking (r=.28/r=.15). Family instability, aggression, and mating orientation were significantly associated with the six indicators of environmental stress. There were however several inconsistent findings. Although pubertal onset was significantly and negatively related to both aggression (r=-.10) and sensation seeking (r=-.15, p<.01), it was unrelated to mating orientation (r=-.04, p>.05) and family instability (r=.02, p>.05). Sensation seeking was significantly related to all dependent measures and environmental stressors (p<.05) but not to family instability (r=.07, p>.05), whereas impulsivity was related to family instability (r=.30), aggression (r=.33) and mating orientation (r=.24) but not pubertal onset (r=-.04, p>.05).

Structural Models

SEM was used to test the assumptions of psychosocial acceleration theory in which the family plays a pivotal role (see Figure 1). According to Belsky et al., (1991) and Chisholm (1999), the presence of environmental stressors increases family instability. This conveys the expectation of a shorter life which should increase levels of sensation seeking and impulsivity (representing potential "time preference" mechanisms) and culminate in a suite of strategy-driven behaviours (in this case, pubertal onset, mating orientation and aggression). This model was tested using SEM and evaluated by the same criteria detailed in the method section.

In Figure 11, latent variables are represented by an ellipse, observed variables by rectangles. All independent variables were specified as intercorrelated to reflect the interactive effects of these variables within an environment. Error terms and intercorrelations are omitted from the diagram for clarity.

Table 35: Descriptive Statistics (M/SD)

Variable	**Overall**
Victimization	5.01 (4.95)
Witnessed Aggression	6.02 (4.50)
Family Instability	16.59 (7.92)
Density	1.15 (.83)
Sex Ratio	1.49 (.70)
Youth Density	1.32 (.82)
Life Expectancy	80.48 (13.11)
Sensation Seeking	3.52 (1.46)
Impulsivity	2.57 (1.79)
Age of Puberty	11.59 (1.34)
Aggression	6.35 (5.54)
STM/LTM	5.02 (3.42)

This family mediation model was an inadequate fit to the data (df = 754, X^2 =1825.36, p<.001, CFI = .89, RMSEA =.05). Sex ratio and witnessed aggression had no significant effect on family instability, whilst impulsivity had no significant effect on pubertal onset. Life expectancy failed to significantly predict sensation seeking. However, all other links in the model were significant to p<.05. Somewhat contrary to theory, pubertal onset and sensation seeking appear functionally independent in the model. This model predicted 17.2% of the variance in aggression, 7.5% of the variance in mating orientation and 2.2% of the variance in age of puberty.

A second model was constructed based on direct and indirect linkages (Copping et al., 2013; Ellis et al., 2009). In this model, sensation seeking and impulsivity were retained as mediators between family instability and strategy-driven behaviours. However, there are now direct pathways between family instability and behaviour (allowing family instability to have direct effects independently of personality). Life expectancy was not treated as a direct result of family instability. Instead, it was treated as an extrinsic source of perceived mortality with a pathway linking it to family instability (in the same way as the other environmental variables). Life expectancy now represented other sources of mortality risk that could shorten lifespan beyond those factors directly measured in the model. Pathways were inserted linking environmental stressors (density, youth density, sex ratio, life expectancy, victimization and witnessed aggression) directly to pubertal onset, mating orientation and aggression. Figure 12 illustrates this model, again showing only significant pathways to aid in interpretation.

Table 36: Table of correlations for all variables

Variable	Victimization	Witnessed Aggression	Family Instability	Density	Sex Ratio	Youth Density	Life Expectancy	Sensation Seeking	Impulsivity	Age of Puberty	Aggression
Witnessed Aggression	.62**										
Family Instability	.32**	.24**									
Density	.09*	.11**	.31**								
Sex Ratio	-.03	0.01	.14**	.17**							
Youth Density	.10*	0.08	.25**	.30**	.15**						
Life Expectancy	-.15**	-.12**	-.23**	-.08	-.02	-.01					
Sensation Seeking	.21**	.19**	.07	.08	.03	.01	-.06				
Impulsivity	.29**	.24**	.30**	.05	-.04	-.02	-.15**	.20**			
Age of Puberty	-.07	-.06	.02	.04	-.02	.02	.03	-.15**	-.06		
Aggression	.68**	.56**	.36**	.14**	.01	.11**	-.18**	.28**	.33**	-.10*	
STM/LTM	.27**	.23**	.48**	.20**	.21**	.14**	-.15**	.15**	.24**	-.04	.31**

* p<.05, **p<.01

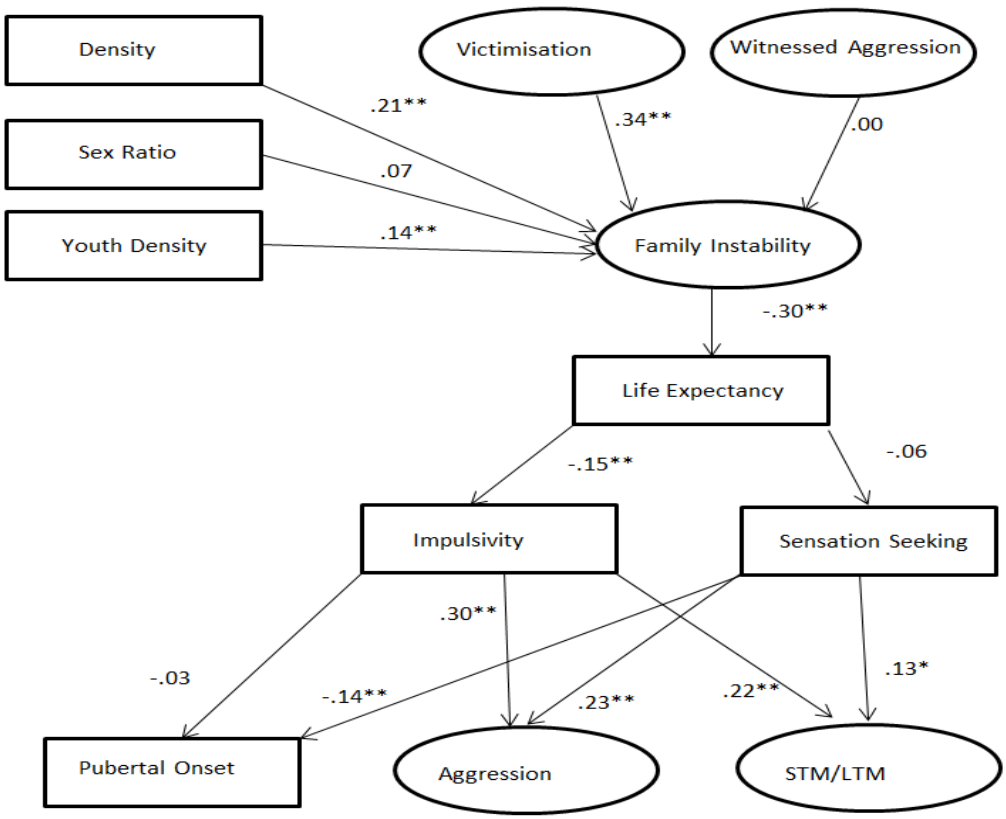

Figure 11: Family instability model

*=<.05, **=<.01

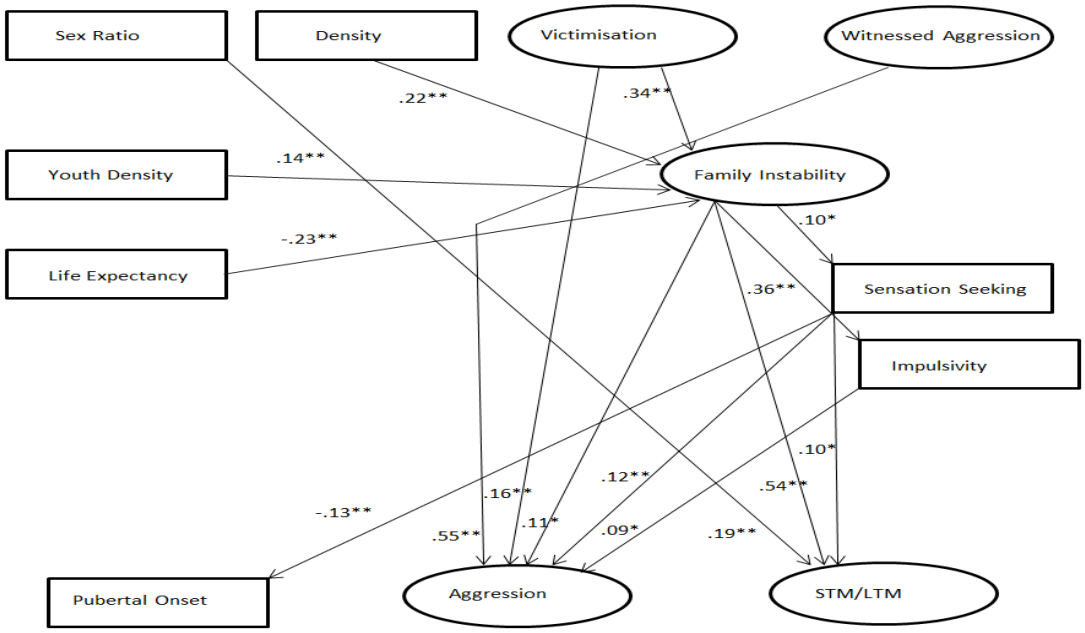

Figure 12: Direct environmental effects model

*=<.05, **=<.01

This model based on direct and indirect linkages fitted the data adequately (df = 728, X^2 =1374.33, p<.001, CFI = .93, RMSEA =.04) and was a significantly better fit than the family mediation model (df_{diff} = 21, X^2 = 451.03, p<.001). Significant links between environmental variables and family instability remained and did not differ significantly from the family mediation model. However, witnessed aggression and victimization had significant direct pathways to aggression. Sex ratio also directly predicted mating orientation. The variance explained in life history outcomes was much higher in this model: 60.6% in aggression, 39.6% in mating orientation and 2.7% in pubertal onset.

A final model (Figure 13) was created in which environmental variables were linked to impulsivity and sensation seeking (as well as directly to strategy-driven behaviours), as it is possible that the environment has direct effects upon personality independent of the effects of family instability. All links in the previous model remained significant. This model was also adequate (df = 716, X^2 =1320.44, p<.001, CFI = .94, RMSEA =.04) and was significantly better than the second model (df_{diff} = 12, X^2 = 53.89, p<.001). Victimization significantly predicted both sensation seeking and impulsivity. High levels of youth density also significantly predicted levels of impulsivity. However, other links between environmental variables and personality variables were non-significant. The variance explained in life history outcomes was similar to that of the previous model: 62.3% in aggression, 39.5% in mating orientation and 3.2% in pubertal onset.

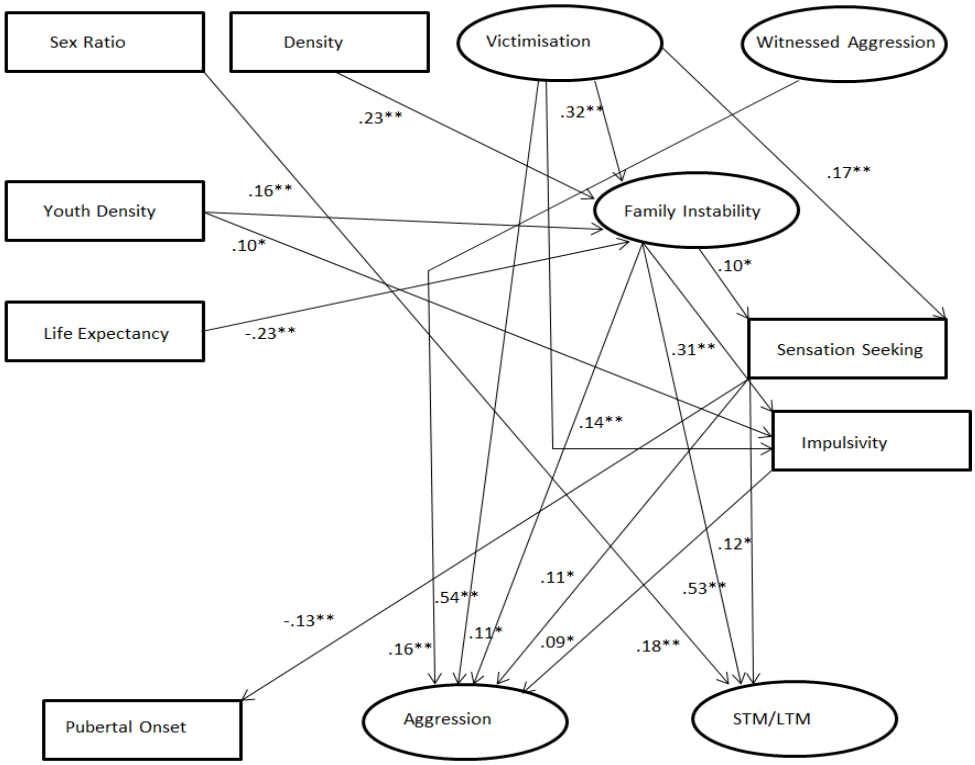

Figure 13: Multi level model

*=<.05, **=<.01

Discussion

This study sought to examine the key tenets of psychosocial acceleration theory as comprehensively as possible. Although the cross-sectional design limits causal inferences, the emerging relationships were supportive of the accruing body of literature. In the family mediation model (Model 1) environmental variables were specified as acting through their effect on family stability which in turn affected life expectancy and time perspective. This model demonstrated that models relying on family instability as the mediator between the environment and strategy (Belsky et al., 1991; Chisholm, 1993) do not fully account for the variance in the data (although the model came close to statistical adequacy). Models 2 and 3 which incorporated broader effects of perceived environmental cues acting directly as well as indirectly on strategic behaviours (Ellis et al., 2009). In model 2 (direct environmental effects model), environmental factors were allowed to correlate directly with behavioural outcomes as well as indirectly through the family and personality. In model 3 (multi-level model) the environmental factors were allowed to correlate directly with all mediational and behavioural variables. These models were better fits to the data and explained substantially more of the variance in life history variables, supporting previous work (Copping et al., 2013a; 2014a). The most comprehensive model (multi-level model) demonstrated that the environment can significantly and independently affect all levels of the model (family instability, personality and behaviour). This suggests that studying specific nodes and linkages in isolation is unlikely to capture the complexity of variables predicting life history outcomes in developing individuals. It is important to note that these more comprehensive models did not contradict the family mediation model, but rather enhanced its explanatory power. Discussion focuses on the core findings from the models.

Family instability

All three models were united in demonstrating the importance of family instability in relation to strategy development and "time preference". In the direct environmental effects model and the multi-level model, family instability was significantly related to both aggression and short term mating orientation (although more strongly to the latter than the former) independent of sensation seeking and impulsivity. In the family mediation model, the impact of family instability on behaviour was represented through its effects on life expectancy and then personality. This supports a body of evidence that unstable family units lead to increased aggression and a greater proclivity towards short term mating behaviours (Copping et al., 2013, under review a; Chisholm, 1993, Chisholm et al., 2005). However it is modelled, the overwhelming influence of a stable family unit does not diminish. Whilst the family mediation model in its entirety did not fit the data (Figure 11), it should be noted that only victimization, witnessed aggression, sex ratio and youth density had significant direct effects on time preference variables or behaviour (Figure 13).

The relationship between family instability and pubertal onset was more complicated however. According to Belsky et al. (1991), family instability should be predictive of pubertal onset. In the family mediation model, no significant pathway from family instability to pubertal onset was found. Only sensation seeking, which was unrelated to family instability, was associated with pubertal onset. This is contrary to psychosocial acceleration theory. However, the direct environmental effects model and the multi-level model

(which encompass all interrelationships) did show a modest but significant link between family instability and sensation seeking, which weakly predicted pubertal onset. However, these weak links with puberty must be interpreted with caution. The most likely cause is measurement unreliability. Puberty was measured retrospectively which is far from ideal, particularly for boys where the physical signs are less obvious. Alternatively (or additionally), the lack of association may be due to the contemporaneous measure of family instability. Psychosocial acceleration theory suggest that the developmentally sensitive period for the impact of stressors is somewhere within the first five years of life (Belsky et al., 2007; Bereczkei & Csanaky, 1996; Quinlan, 2003). It may be the case that current family instability does not capture these earlier key experiences. Simpson et al., (2012) demonstrated that life history outcomes (number of sexual partners, aggressive, criminal and delinquent behaviour) were better predicted by indicators of early harshness and unpredictability (at ages 0-5) than later harshness and unpredictability (at ages 6-16). In the present study, the weak associations between family instability, sensation seeking and pubertal onset may be a result of the use of concurrent measures (at ages 13-18) in a cross-sectional design. Only longitudinal replications of this model can allow firmer conclusions about the effects of rearing environment on age of puberty.

The Environment

The environmental variables examined in this study were all implicated in the development of life history strategies, supporting previous work (Copping et al., 2013, 2014a). Environments perceived to be characterised by violence, crowding, higher mortality and an excess of females were conducive to increasing levels of family stress and ultimately, faster life history strategies.

Supporting previous works, key environmental variables had their effects at different levels; on the family, personality and behaviour. The multi-level highlights victimization as playing a key role in increasing levels of family instability, impulsivity, sensation seeking, and expressed aggression. It has a larger effect on family instability and aggressive behaviour than any other environmental variable. This finding reaffirms the long held belief that environments characterized by violence (both in the home and beyond) foster greater violence in developing children, creating a cycle that is difficult to break (Dodge, Bates & Pettit, 1990; Perry, 1997). Although witnessed aggression and victimization were correlated, witnessing local aggression impacted exclusively on expressed levels of aggression while aggressive victimization was also associated with family instability and personality. It may be the case that whilst observing aggression makes individuals moderately more likely to use it themselves, only suffering its effects directly creates additional strains on the family and alters personality structures. This is possibly due to the fact that participants may have been suffering this victimization within the family unit itself (although our measures did not specifically address this).

The effect of sex ratio was weak and not wholly consistent with previous results (Copping et al., 2013a; Guttentag & Secord, 1983). Whilst there was a weak direct relationship between sex ratio and short-term mating (i.e., a surplus of women is associated with more short term mating), the same effects were not observed in aggressive tendencies or early maturation. Unlike previous research, we focused on the sex ratio as perceived by the respondent. Few studies have attempted to measure individual's perceptions of the population composition around them. It is therefore interesting that a perceived sex ratio skew was associated with a more favorable

orientation to short term mating, consistent with existing theoretical and empirical literature. A female-biased population creates market forces favoring men: men have opportunity to potentially mate with more women and women respond by lowering their minimum expectations of male fidelity and monogamy, losing control of the marriage market (Barber, 2000b; Guttentag & Secord, 1983). Greater emphasis on individual's perception of mating opportunities should be a focus of future research.

The effect of greater population density was confined to the family where it increased instability, presumably causing familial stress through increased competition for local resources or because the pool of available mates is larger and thus may encourage unstable pair-bonds. Youth density also had this effect but was additionally associated with greater impulsivity, perhaps as an adaptive response to conspecific competition, where the need for snap decisions would be potentially beneficial if it secured resources, or prevented injury or premature death (Chisholm, 1999a; Gardner, 1993). As with sex ratio, we measured perception of density rather than recorded density, in contrast to most macro level studies. Although the family unit can be disrupted by perceived density, it appears that aggression and sexual behaviour are not directly exacerbated by it. These results highlight the need for work to move from macro to micro levels, whilst still maintaining a broad conceptualization of the environment.

Anticipation of a shorter life expectancy was an important predictor of family instability, supporting Chisholm's proposal. Environments characterized by threat and diminished life expectancy increase the stress of child rearing and likely facilitate the development of insecure and avoidant attachments between parents and children, thus increasing the likelihood of a faster life history strategy. As with other independent variables in this study, despite zero-order correlations with behavioural outcomes (as found in previous works: Copping et al., 2013a; Wilson & Daly, 1997), life expectancy in the full model contributed significantly only to explained variance in family stability, again attesting to the pivotal role of the family unit in socialization and development (Belsky et al., 1991; Chisholm, 1993). Perceived life expectancy was included in the study to examine mortality risk from unspecified sources. It may be that direct pathways in this model are not found between life expectancy and behaviour because variance from sources of mortality associated with other independent variables is subsumed by existing model pathways. The fact that estimated life expectancy had a negative effect on family instability suggests that some residual elements of mortality risk are being perceived that are not associated with other variables in the model. We suggest (based on previous work) that some of these key factors are likely to be economic and educational conditions which show very strong correlations with life expectancy, strategy behaviours and family instability in macro studies (Copping et al., 2013), but which could not be sensitively measured in this study. The specification of these variables in further studies should be a research imperative. Demographic risk factors associated with earlier death (race, class, nationality etc.), pathogenesis (Schaller & Murray, 2008; Thornhill & Fincher, 2011), and physical health as perceptible cues to mortality should be a research priority.

Time preference

A key aim of this study was to examine psychosocial acceleration theory and its later extensions, including the hypothesized psychological mediator of time preference (Chisholm, 1999a). Based on previous

empirical work (Copping et al., 2013b; 2014b; Hill et al, 1997; Krueger et al., 2008), we targeted two variables that we considered strong candidates to represent this important mechanism: impulsivity and sensation seeking, representing components of affective, effortful control (MacDonald, 2008). As hypothesized, sensation seeking appeared to be the key mechanism, impacting on pubertal onset, aggression and mating orientation in expected directions. Impulsivity however, also played a role in the explanation of aggressive behaviour. Psychological mechanisms are clearly important in the expression of life history strategies and from the current data, we tentatively draw the following conclusions.

First, impulsivity and sensation seeking, whilst weakly inter-correlated, act independently: they impacted on and were impacted by different variables in the model. This supports the contention that time preference is not a unitary construct (Copping et al., 2013, 2014b, Loewenstein and O'Donoghue, 2002; Loewenstein et al, 2001; Teuscher & Mitchell, 2011).

Second, sensation seeking and impulsivity work in different ways in strategy formation, consistent with traditional dual process models of behavioural regulation (Carver & White, 2005; McDonald, 2008). Whereas many candidates for time preference in the literature (such as delay discounting or time perspective) represent higher-order 'cold' executive functions, impulsivity and sensation seeking represent facets of evolutionarily older subsystems, governing reward responsiveness and socio-affective inhibition. Sensation seeking represents hyper- attraction to reward (BAS) rooted in the dopaminergic system. Impulsivity is the failure to inhibit these prepotent responses, representing a failure of effortful control. The two constructs act in distinct ways. Most life history related behaviour is rewarding (on some level), be it the satisfaction from sexual behaviour or the appropriation of rewards from competitors through aggressive and risky competitive behaviour. Although a stronger BAS response would be adaptive under consistently unpredictable conditions (Chisholm, 1999a; Gardner, 1993), unrestrained reward responsiveness could be detrimental to survival (MacDonald, 2008). Punishment and injury from aggressively reacting to every perceived threat or mating opportunity would eventually lead to fitness consequences. Effortful, affective control evolved to modulate the consequences of approach or withdrawal by suppressing BAS activity. Uncertain environments during development appear to increase BAS activity and weaken effortful control, resulting in greater expression of risky behaviours associated with faster life histories despite the potential costs that these actions may entail.

Limitations, future directions and conclusions

Several limitations of this study have already been mentioned. Most can be addressed through longitudinal designs Whilst there are several examples of longitudinal studies examining some variables and pathways in the model (Belsky et al., 2012; Brumbach, Figueredo & Schneider, 2009; James et al., 2012; Nettle, 2010; Simpson et al., 2012), these studies have not fully tested all levels of psychosocial acceleration theory (although we acknowledged that this is no small task). Although several studies have demonstrated important effects using cross sectional designs and concurrent data (Brumbach et al., 2009; Hill et al., 1997), only a comprehensive longitudinal design will resolve temporal, causal and mediating issues that are currently ambiguous. We also acknowledge that the current research used self-report data. While it might be argued that this raises validity concerns (notably in the case of recall of pubertal onset), we maintain that environmental

effects on individual behaviour are likely mediated by perception which can only be accessed via subjective report.

This study has shown that the environment is a complex microcosm of interrelated factors which has cascading effects on behaviour through the family, psychological mechanisms and directly. The psychological mechanisms governing approach behaviours and socio-affective regulation also seem crucial to the modulation of life history behaviours. This study has shown that a synthesis of evolutionary, developmental and personality psychology can lead to insightful conclusions about how aggression and sexual behaviours emerge and further refinements of these ideas may enhance our understanding of life history strategies in human populations.

5.2. Environmental Stress and Life History Strategy: Are strategies different between the sexes?

Theoretical background and aims

Life history strategies are visible in behaviours, specifically, those that enhance fitness potential (reproductively successfully offspring). As individuals develop in their environmental niche, life history theory proposes that their strategy is shaped to secure reproductive fitness by regulating age of maturity and later sexual and competitive behaviours (Belsky, Steinberg & Draper, 1991). As we have seen in the previous study, this is the core principle of psychosocial acceleration theory.

A striking feature of reproductive and competitive behaviours is the consistent emergence of sex differences. Males are universally more aggressive (Archer, 2004; Bettencourt & Miller, 1996, Eagly & Steffen, 1986), more sexually unrestricted and they seek more sexual partners than females (Buss & Schmitt, 1993; Penke & Asendorpf, 2008; Trivers, 1972). Females however reach puberty significantly earlier than males (Del Giudice, Angeleri & Manera, 2009; Tanner, 1990). Furthermore, potential behavioural mediators such as sensation seeking also show a strong male bias (Cross, Copping & Campbell, 2011). Sex differences emerge in behaviour due to the different reproductive optima of the sexes (Bateman, 1948; Trivers, 1972). Whilst recent work challenges the notion that anisogamy alone is not sufficient to explain sex differentiated roles in their entirety (see Kokko & Jennions, 2008) most evolutionary theorists consider that it can be advantageous for males to take aggressive and sexual risks that increase the chances of successful reproduction when variances between males is high (Young Male Syndrome: Wilson & Daly, 1985). The impetus for risk taking is lower in females as risks to their health will lead to fitness consequences in offspring (Campbell, 1999). It is therefore unlikely that a single developmental trajectory would apply equally to males and females (Copping et al., 2014; Muncer, 2013) given that the constraints governing the reproductive behaviours of the sexes differ.

There is a degree of ambiguity in the treatment of biological sex in psychosocial acceleration theory and its later extensions (Chisholm, 1999a; James, Ellis, Schlomer and Garber, 2012). Whilst most life history theorists accept that sex differences emerge in strategy behaviours (Bailey, Gaulin, Agyei and Gladue, 1994; Chisholm, 1999a; Del Giudice, 2009a; Del Giudice and Belsky, 2010; Ellis et al., 2012), there has been little empirical work that examines the development of trajectories as a function of sex. Furthermore, most research examining the core tenets of the model, particularly in the domain of reproductive maturation, focuses almost exclusively on female samples, with little consideration of whether results can be generalised to males. Theoretical and empirical work suggests that sex-specific pathways are likely. A brief review follows.

Sex differences in strategy development

Belsky et al., (1991) and Chisholm (1999a) suggest that childhood stress during the first five to seven years of life is critical in strategy development. During this time, attachment formation and the development of internal working models which guide later attachment patterns (Ainsworth, Blehar, Waters & Wall, 1978) are affected by the level of bonding between parents and children. Del Giudice (2009a) suggested that sex differentiation in strategy development begins around the time of this key developmental point, and that sex differences in attachment styles emerge as early as ages six or seven. Whilst secure attachment bonds in stable

environments tend to promote slower strategies, disruption to parent-child bonding leads to insecure attachments. Insecure attachment, father absence and stressful rearing environments are some of the risk factors most consistently linked to the expression of behaviours associated with fast life history strategies (Belsky & Fearon, 2002; Belsky et al., 1991; Buehler & Gerard, 2002; Draper & Harpending, 1982; Webster, Graber, Gesselman, Crosier & Schember, 2014). However, insecure attachments can be divided into two broad categories: avoidant and anxious/ambivalent (Brennan, Clark & Shaver, 1998). Del Giudice (2008, 2009a; Del Giudice & Belsky, 2010) provided and reviewed evidence demonstrating that in middle childhood (approximately ages seven to twelve), insecure males tend to adopt an avoidant style, whilst females adopt anxious and ambivalent styles. Sex differences in adult attachments also showed similar patterns in a meta-analysis of romantic attachment types (Del Giudice, 2011). A similar, cross-cultural meta-analysis by Schmitt et al. (2003) corroborated these findings. Interestingly, the adoption of insecure forms of attachment was strongly moderated by factors associated with uncertain, unpredictable and harsh environments with higher mortality rates (Chisholm, 1999a, Ellis, Brumbach, Figueredo & Schneider, 2009). Given that attachment represents one of the corner stones of life history strategy development, sex differences in its manifestation would presumably translate into sex differences in strategy expression.

Del Giudice (2009a) suggested that the mechanism responsible for sex differentiation in later strategy formation (beyond differences in initial attachment formation) is the process of adrenarche, occurring at around ages five to eight in males and females, beginning what is termed "the juvenile transition". Del Giudice, Angeleri and Manera (2009) proposed that early attachment in childhood (up to age seven) acts as an assessment that establishes the ecological security of the environment in order to correspondingly adjust the trajectory of the developing phenotype (consistent with the ideas of Belsky et al., 1991; Chisholm, 1993). The results of this assessment determine the onset of adrenarche. This switch point causes the secretion of adrenal androgens that are converted into sex hormones and affect physiological functioning and development, including behaviours such as promiscuity and aggression which show increasing degrees of sexual dimorphism during this developmental stage (and into adolescence post puberty). Indeed, Del Giudice et al. (2009a) review evidence to suggest that from age seven until the onset of adolescence, behaviour becomes increasingly differentiated by sex, with heightened differences in aggression, locomotor and exploratory play, linguistic competence and increasing sex segregation. He (and later Del Giudice & Belsky, 2010) argued that these sex differences are consistent with predictions derived from sexual selection and parental investment theories and that these asymmetries are adaptive across developmental stages. Ellis and Essex (2007) demonstrated that greater family conflict and poorer quality parental investment predict earlier adrenarche in both sexes and, in females, earlier menarche. Del Giudice et al. suggested that puberty is an additional switch point that facilitates further adaptive plasticity on the road to adult maturity, where development (including sexually dimorphic development) continues. The key point is that risk and uncertainty in early childhood (ages five to seven) can affect the onset of adrenarche and in turn, puberty, accelerating life history strategies whilst remaining (to a certain degree) sexually dimorphic. Evidence for sex differences in the early stages of strategy development is therefore compelling when viewed in a life history perspective and the role of biological sex appears crucial for further study.

Recent longitudinal work has examined sex differences in strategy development. James et al., (2012) assessed boys and girls at ages 11, 12, 13 and 17 on measures of family context (including father absence and maternal depressive symptomatology), SES, pubertal onset, self-perceived mate value, sexual debut and sexual risk taking. Structural equation modelling was used to test the key components of psychosocial acceleration. Results supported most of the proposals of Belsky et al. (1991). Higher levels of father absence and maternal depressive symptomology were linked to a lower quality of family relationships. In girls (but not boys), poorer family relationships were linked to earlier pubertal onset. Also in girls, SES and family relationships had significant indirect effects on sexual debut and risky sexual activity. Father absence directly predicted sexual debut and sexual risk taking, but not pubertal timing. Whilst in both sexes high perceived mate value increased the likelihood of earlier sexual debut, for males (but not females) the relationship between pubertal maturation and sexual debut was partially mediated by self-perceived mate value. This study therefore offers compelling evidence that males and females have different pathways to sexual behaviours during development.

Copping, Campbell and Muncer (2014) also demonstrated significant effects of biological sex in psychometric measures of life history strategy. Using the High K Strategy Scale (HKSS – Giosan 2006), they showed that in women, environmental security, environmental stability and personal capital (synonymous with mate value) were significant only in their relationship to earlier puberty, with higher levels of these three variables predicting delayed onset. In men but not women, these same variables (with the exception of environmental security) predicted lower ages of sexual debut and an increased number of sex partners. Whilst these relationships are inconsistent with the original formulation of psychosocial acceleration theory, they are consistent with sexual selection theory. In men, higher status affords greater opportunity for fitness benefits (Trivers, 1972), making them attractive to females and allowing greater mate access (Borgerhoff Mulder, 1990, 1992; Buss and Schmitt, 1993; Draper, 1989; Kanazawa, 2003; Perusse, 1993). Men with greater environmental stability and social capital are more likely to be successful at intersexual competition (Gangestad & Simpson, 2000; Jackson & Ellis, 2009) and earlier sexual debut increases their window of opportunity to increase reproductive success. The results reported by James et al. (2012) support this contention.

Sex differences in reproductive optima, intensity of intrasexual competition, life history traits (such as aggression and sexual behaviours) and forms of disrupted attachment during middle childhood support the hypothesis of sexually differentiated pathways to life history strategies. Taken together, evidence for sexually differentiated patterns of strategy development is persuasive. It seems probable that environmental information acquired during development is likely to be received, interpreted and acted upon differently by the two sexes (Gangestad & Simpson, 2000; Jackson & Ellis, 2009; James et al., 2012). Unfortunately, how males and females respond to cues in the environment has received little empirical attention in the current literature. The conceptualization of the environmental cues implicated in strategy determination is vague and often generalised across sex. However, many factors cited as environmental stressors would be hypothesised to have independent effects on traits under sexual selection pressures and would affect parental investment strategies (Del Giudice, 2009a; 2012; Kokko & Jennions, 2008). A similar lack of consideration has also been given to proposed psychological mediators of strategy behaviour such as Chisholm's (1999a) time preference construct.

Aims of current analysis

The aim of this analysis was to expand the results of the previous model of psychosocial acceleration theory (Copping and Campbell, 2014 under review). Whilst several core tenets of this theory were tested by James et al., (2012), the model in its entirety has not been examined. This complex developmental model was here examined as a function of sex (which is seldom done) in order to study possible sexually dimorphic effects of antecedent variables and mechanisms. Whilst the overall model presented in the original study supported the tenets of psychosocial acceleration theory (see Figure 13), we predicted that splitting the sample by sex would reveal differences in pathways and thus strategy determination, highlighting the point that a gender-neutral view of strategy is insufficient if we take seriously the differing reproductive goals of the sexes. Data, analysis, sample and methods implemented here were identical to the preceding paper. Please refer to Copping and Campbell (2014 under review) for details.

Results

Table 37 presents descriptive statistics for each variable by sex with significant differences starred. All but three of the variables (family instability, density and youth density) in this study demonstrated significant sex differences. Table 38 shows correlations between all variables by sex. As there are many significant correlations, only those showing sex differences are explored below.

Correlations between environmental variables and life history behaviours demonstrate many significant sex differences. Sex ratio had significant links with short term mating orientation in males (r = .36, p < .01) but not females (r = .04, p > .05). Population density was significantly related to aggression in females (r = .18, p < .05) and short term mating in males (r = .33, p < .01). Youth density was significantly related to aggression and short term mating in males (r = .15, p < .05 and .22, p < .01 respectively) but not females (r = .07, p > .05 and .04, p > .05 respectively). Life expectancy was significantly related to aggression in females (r = -.26, p < .01) but was not in males (r = -.09, p > .05). Increasing levels of victimization were associated with earlier puberty in males (r = -.14, p < .05) but not females (r = .02, p > .05), the same was true for witnessed aggression in the environment (r = -.13 p > .05 in males and .01, p > .05 in females).

There were few sex-specific correlations in the proposed mediator variables in the model. Sex ratios biased towards females significantly increased family instability in males (r = .32, p < .01) but not in females (r = -.04, p > .05). Sensation seeking was the only personality variable to have a sex-specific effect, correlating significantly with short term mating orientation in males (r = .20, p < .01) but not females (r = .07, p > .05).

Models by sex

As sex differences were evident at the level of variables and correlations, the final model from Copping et al., (2014 under review) was examined separately for each sex. Figure 14 shows the significant linkages for males, whilst Figure 15 shows the significant linkages for females. Both models were a parsimonious fit to the data (For males: DF = 716, X^2 =1108.94, p < .001, CFI = .92, RMSEA = .05. For females: DF = 716, X^2

=1115.09, $p < .001$, CFI = .92, RMSEA = .04). However the patterns of relationships between variables were very different.

Table 37: Descriptive Statistics (M/SD)

Variable	Male (N = 252)	Female (N=311)
Victimization**	5.87 (5.12)	4.31 (4.69)
Witnessed Aggression**	6.77 (4.58)	5.41 (4.34)
Family Instability	16.88 (8.36)	16.35 (7.55)
Density	1.14 (.87)	1.16 (.81)
Sex Ratio*	1.56 (.75)	1.43 (.66)
Youth Density	1.36 (.83)	1.28 (.80)
Life Expectancy*	79.02 (14.44)	81.65 (11.83)
Sensation Seeking*	3.67 (1.41)	3.40 (1.45)
Impulsivity	2.65 (.11)	2.51 (.10)
Age of Puberty**	11.41 (1.27)	11.73 (1.38)
Aggression*	6.93 (5.49)	5.89 (5.55)
STM/LTM**	5.64 (3.69)	4.51 (3.10)

* p<.05, **p<.01

For males, life expectancy and pubertal onset were not significantly related to any of the variables in the model. Variables pertaining to the makeup of the population (density, youth density, sex ratio and victimisation) however were significant in predicting family instability and impulsivity. Sex ratio also had stronger direct and indirect effects in the male model. For males, family instability had no effect on aggression or sensation seeking. However, significant links between family instability and impulsivity, and between impulsivity and aggression remained. Interestingly, the direction of relationships between impulsivity and sex ratio, and between impulsivity and youth density reversed, suggesting that male impulsivity is higher in populations with a greater numbers of older males. The male model predicts 65% of the variance in aggression, 55% of the aggression in mating behaviour but only 5% of the variance in age of puberty.

The female model was very different from the male model, with fewer significant pathways. Sex ratio, density and youth density had no significant links to any other variables in the model. Life expectancy however was still a significant predictor of family instability which, in turn, was the exclusive predictor of mating orientation. Whilst impulsivity was related to family instability, it had no effects on puberty, aggression or mating orientation. However, sensation seeking in females did predict puberty and aggression. Sensation seeking was not linked with family instability in females but was instead predicted by levels of victimisation and perceived aggression in the environment. The female model predicts 61% of the variance in aggression, 27% of the variance in mating behaviour but only 4% of the variance in age of puberty.

Table 38: Table of correlations for all variables by sex (M/F)

Variable	Victimization	Witnessed Aggression	Family Instability	Density	Sex Ratio	Youth Density	Life Expectancy	Sensation Seeking	Impulsivity	Age of Puberty	Aggression
Witnessed Aggression	.66**/.56**										
Family Instability	.26**/.38**	.17**/.30**									
Density	.03/.16**	.06/.16**	.39**/.23**								
Sex Ratio	-.01/-.08	-.01/.00	.32**/-.04	.20**/.13*							
Youth Density	.15*/.04	.13*/.02	.32**/.17**	.28**/.32**	.25**/.05						
Life Expectancy	-.06/-.21**	-.06/-.16**	-.14*/-.32**	-.11/-.04	-.08/.06	.04/-.05					
Sensation Seeking	.26**/.15**	.18**/.18**	.06/.08	.12/.05	.06/-.02	.00/.00	-.04/-.06				
Impulsivity	.31**/.26**	.22**/.24**	.31**/.29**	.11/.01	-.09/.00	-.06	-.10/.01	.21**/-.19**			
Age of Puberty	-.14*/.02	-.13*/.01	-.04/.08	-.01/.08	-.05/.03	.03/.03	.12/-.07	-.14*/-.13*	-.06/-.05		
Aggression	.68**/.68**	.62**/.50**	.31**/.41**	.09/.18**	.06/.07	.15*/.07	-.09/-.26**	.30**/.25**	.37**/.30**	-.18**/-.02	
STM/LTM	.30**/.20**	.18**/.23**	.57**/.38**	.33**/.06	.36**/.04	.22**/.04	-.15*/-.13**	.20**/.07	.25**/.22**	-.07/02	.34**/.26**

* p<.05, **p<.01

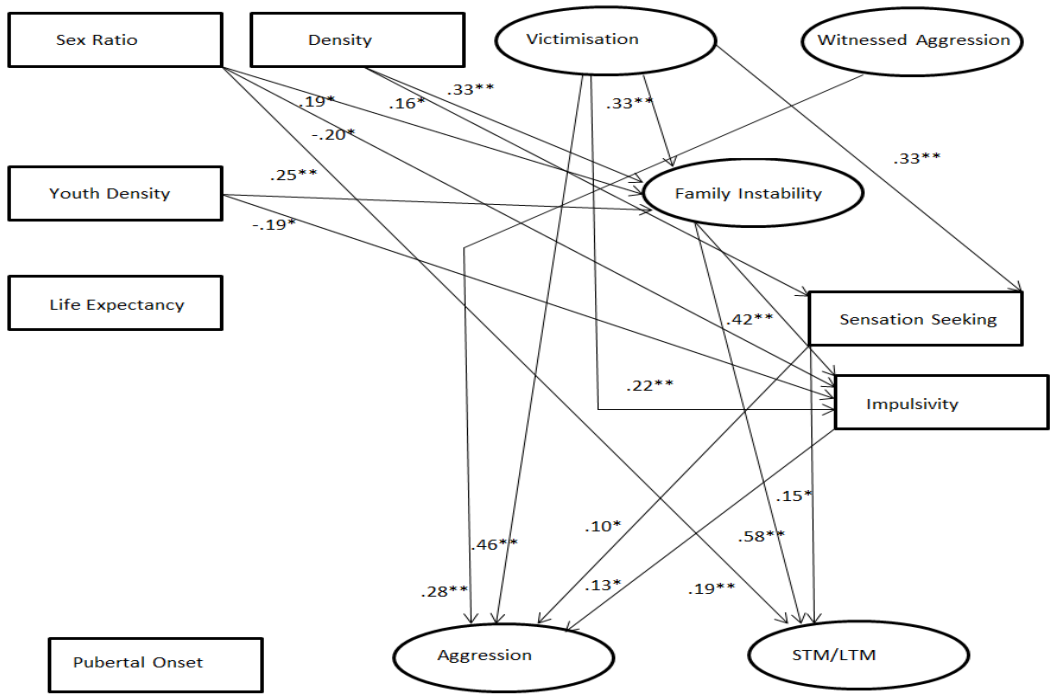

Figure 14: Complete model of psychosocial acceleration theory in males (N = 252)

*=<.05, **=<.01

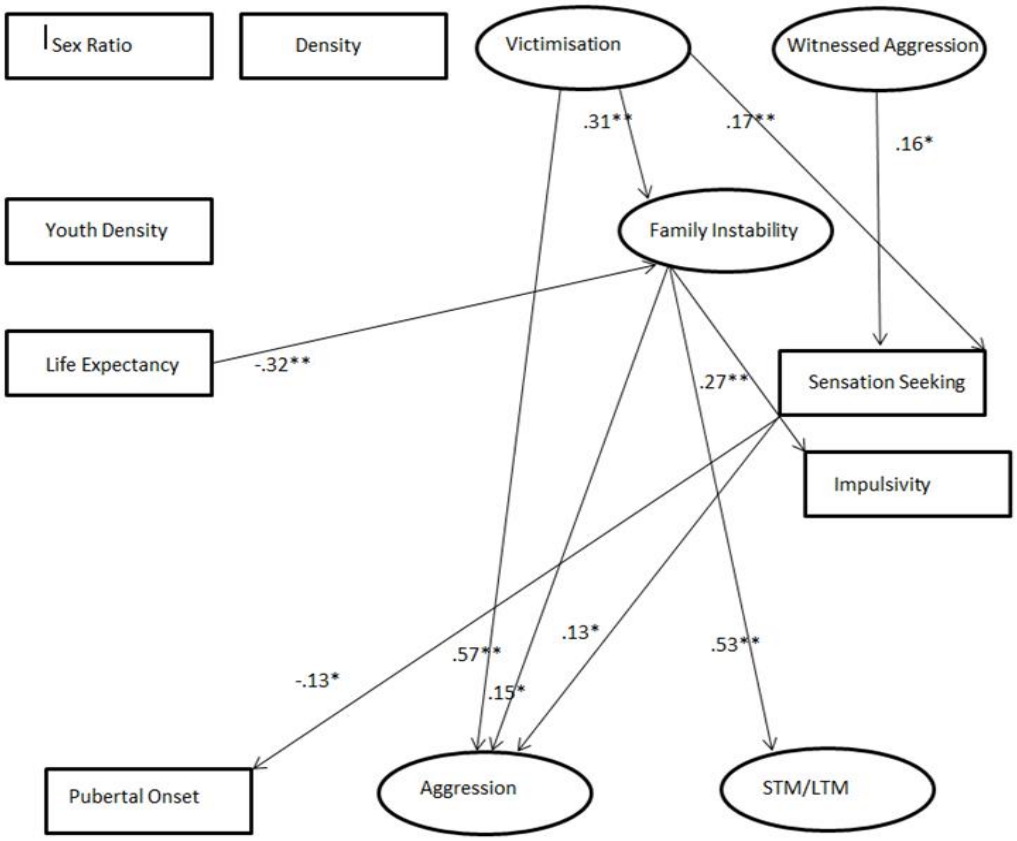

Figure 15: Complete model of psychosocial acceleration theory in females (N = 252)

*=<.05, **=<.01

To further test the proposition that this model differed as a function of sex, the male and female models (figures 14 and 15) were treated as baseline models to determine which pathways were common to both sexes. The full model (Figure 13) was constrained so that every pathway was treated as invariant between males and females. This model was a good fit to the data set (DF = 1527, X^2 =2416.76, p < .001, CFI = .91, RMSEA = .03). The model was then re-specified; removing all constraints except for those pathways common to both sexes (which were: victimisation to family instability/victimisation to sensation seeking/sensation seeking to aggression/family instability to impulsivity/family instability to mating orientation). All remaining parameters were allowed to vary freely between the sexes. This re-specified model was also a good fit to the data set (DF = 1439, X^2 =2230.78, p < .001, CFI = .92, RMSEA =.03), with a lower X^2 and a slightly improved CFI. The difference between the two models was significant (DF_{diff} = 78, X^2_{diff} = 185.98, p < .001) thus showing that many pathways in this model vary when biological sex is considered.

Discussion

These data demonstrate striking sex differences in the way that behaviour is influenced by environmental stress. The original model presented in Copping et al. (2014 under review) was congruent with psychosocial acceleration theory as it is normally represented in contemporary literature (Belsky, et al., 1991; Chisholm, 1999a). Whilst this pattern holds over the general population, splitting the data by respondent sex revealed sex-specific pathways to behaviour. Although the pathways between variables in the model differed between the sexes, the amount of variance explained for each sex in aggression and pubertal onset were strikingly similar. However, orientation towards short term mating was predicted twice as effectively in the male model than the female model (55% to 27% variance explained respectively). It is also clear that examining correlations in isolation is not as informative as examining all factors simultaneously as part of a broader multivariate model in which many zero-order relationships do not remain significant.

The most striking difference between these two models is that in females, few of the environmental variables played a significant role. Only one (victimisation) had a direct effect on any of the outcome measures (aggression). Only victimization and life expectancy (indexing mortality risk) had an effect on family instability. This is in stark contrast to the male model where, with the exception of witnessing aggression and life expectancy, all environmental variables had effects on family instability. This seems to suggest that male strategy development may be more contingent on local population dynamics (which increase family instability) whilst their aggression levels appear to be driven mainly by local aggression and personality traits. Females seem to react mainly to sources of immediate threat mainly through the family unit but also directly in the case of aggression. We briefly discuss the key findings of this reanalysis, highlighting the implications of these sex differences.

For females only, a shorter estimated life expectancy is an important stressor effecting family instability beyond victimization, partially supporting Chisholm's predictions to an extent (although Chisholm emphasised that this was equally important for males). Life expectancy in this study represented a proxy for sources of mortality beyond those implicit in other independent variables that were measured. It may be that males do not consider local sources of threat to their lives beyond those that are captured by measures of

'external' mortality risks such as aggressive victimisation, youth density and sex ratio. In estimating life expectancy, females may be sensitive to other factors, especially those associated with less immediate causes of death, such as heredity, diet, and lifestyle (Copping Campbell & Muncer, 2013; Ellis, Brumbach, Figueredo & Schneider, 2009). Young men are also more likely to die from external causes such as violent victimisation (Daly & Wilson, 1988; United States Department of Justice, 2010) and have a shorter lifespan (Lemaire, 2002). Male behaviour appears to be driven more directly by the level of the current competition around them (reflected in sensitivity to broader environmental circumstances) as would be predicted by sexual selection theory.

Previous literature suggests that female-biased sex ratios foster family instability and orientation to short term mating (Barber, 2000; Guttentag & Secord, 1983), but the present data suggest this was true only for males. Zero-order correlations also indicated that sex ratio had significant links with more variables in males than females. This is not wholly inconsistent with sexual selection literature in that males should benefit from being sensitive to sex ratio: they have much to gain in an environment characterised by an excess of women (exploitation of mating opportunities) and much to lose in an environment characterised by larger male populations (more intense intrasexual competition). Kokko and Jennions (2008) suggested that sexually selected behaviours (such as aggression) and mating strategy (investment in parenting versus mating) should vary not just in relation to overall differences in reproductive variances (Bateman, 1948) but from interactions between local operational sex ratios, population densities and mortality rates. In this study, males appear sensitive to most of these factors (life expectancy being the exception), which appear to affect (albeit indirectly) their outcome behaviours. Data from the present study, our earlier work (Copping et al., 2013, under review a) and other theorists (Del Giudice, 2012) suggests that populations are normally slightly skewed towards females (although it should be emphasised that this is in terms of the reproductive adult sex ratio and that these ratios can fluctuate). Consistent with Kokko et al.'s (2008) proposal, the male model may reflect an environment in which increased density and a skewed sex ratio (in this case, a female bias) that increase competition amongst males is associated with the key mediators of family instability and personality. In females, density and sex ratio have no significant pathways in the model suggesting that, while women's strategies appear to be fostered mainly by personal experience of direct aggression and by immediate family instability, males may indeed be tracking local competition and mating opportunities (Gangestad & Simpson, 2000). This is still consistent with traditional evolutionary theory as men are more frequently involved in aggression, reflecting more intense intrasexual competition among males (Campbell, 1999; Wilson & Daly, 1985). The literature also predicts that, in a female-biased population, women would become more promiscuous due to a loss of bargaining power in the marriage market resulting from a paucity of men (Barber, 2000; Guttentag & Secord, 1983). This was not evident in this data set; sex ratios had no significant impact on female strategy development. Because males appear more susceptible to the influences of local population dynamics, it seems likely that men more than women are aware of the prospects of soliciting short-term sexual relationships and are therefore sensitive to the number of local females. Women may not track this ratio directly, but rather respond to the soliciting behaviour of men around them and thus sex ratio may be much more distally related as a causal factor for females. It must be emphasised however that recent theoretical reviews of population composition and sex ratio effects (see De Giudice, 2012; Kokko et al, 2008) indicate that these important variable may act in a complex, interactive

fashion that may be contingent on each other and on additional population factors. More research is needed to clarify the significance of these effects, particularly on human populations.

The direct and indirect role of family instability differed between the sexes. In males, its effects appeared limited to enhancing short-term mating attitudes and impulsivity, whilst in females it additionally affected aggression. As family instability was a common predictor of both deliberative failure and mating attitudes for both sexes, it appears that family instability is more critical in developing internal working models relevant to future reproductive behaviour (with unstable family life leading to the expectation that their own romantic relationships will be equally unstable) and in weakening the ability to suppress socio-affective stimuli, resulting in an increased likelihood of impulsive decision making for both males and females. Stable family units presumably foster restraint in developing children and increase the likelihood of monogamous attitudes whilst reinforcing the need for cautious decisions. These results therefore support the core proposals of psychosocial acceleration theory in that family instability seems to have the largest effects on strategy related behaviours, particularly sexual behaviour and present-orientated decision making (Belsky et al., 1991; Chisholm, 1999a).

The role of personality variables used to represent Chisholm's concept of "time preference" (1999a) differed between the sexes. In females, impulsivity was susceptible to family instability but it had no effect on life history outcomes, whilst sensation seeking was responsive only to witnessed aggression and victimization and predicted pubertal onset and aggression. In males sensation seeking was predicted by victimization and density, which in turn predicted aggression and mating orientation. Whilst reaffirming the importance of reward-seeking behaviours (even in females), sensation seeking's lack of association with family instability in this study is not in keeping with Chisholm's proposals. In males, sensation seeking was also positively associated with victimization and density: sensation seeking in turn then affected aggression. Environments characterised by greater competition appear to create a propensity to seek reward in males, perhaps fostering higher levels of aggression to achieve this and a willingness to react aggressively in response to threats. The tendency to react immediately to threat may be adaptive in hazardous environments. Failure to respond to survival threats is likely to be more serious than responding in error to a misidentified threat (see Haselton & Buss, 2000).

For males, sensation seeking was also predictive of mating strategy. This is again consistent with the evolutionary literature as males have the most to gain from capitalizing on reproductive opportunities. This low-level 'hot' system increases male's tendency to seize mating opportunities. MacDonald (2008) argued however, that unalloyed hyper-responsiveness to reward would not be adaptive due to the potentially risky consequences of acting without premeditation in socio-affective contexts. MacDonald proposed that control of low-level reward responsiveness would be important in quickly suppressing prepotent affective responses where these would be dangerous or inappropriate. In this study, this affective control was measured by impulsivity (failure to deliberate). For males, affective control appears to be weakened where there are high concentrations of older males, unstable family units and high levels of victimization. This is consistent with an evolutionary interpretation of male competition: A higher concentration of older, potentially more experienced and dominant males may force younger males to act more reflexively in order to achieve their goals, consistent with Kokko et

al's. (2008) proposals. Del Giudice (2012) also suggested that as population dynamics alter, personality traits (risk taking and impulsivity amongst others) will be ultimately affected as part of a coordinated life history strategy adaptive to local environments. "Time preference" (as Chisholm conceptualizes it) was more important to male strategy behaviour than to females' in the current data set.

Pubertal onset had only one modest but significant link, and that was with sensation seeking in females. Whilst this is not generally supportive of psychosocial acceleration theory, it does corroborate previous findings in the literature (Copping et al, 2014; James et al., 2012). However, the fact that pubertal timing does not relate to family instability is puzzling given the prominence accorded to this association in the literature (although even here findings have not been unanimous; James et al., 2012). Our failure to find an association between pubertal age and family instability may be due to measurement artefacts (such as retrospective assessments of puberty and contemporaneous measurements of personality and environmental variables), although the more sensitive measures used by James et al. also failed to such an association.

Limitations and conclusions

There were a number of limitations to this analysis as detailed in the original paper. In the present analysis, an additional limitation was that splitting the sample in two has decreased the sample size for testing such a large model and the sample was also biased slightly towards females. Power analysis indicates that a model of this size and complexity would require at least 400 participants to detect an effect size of .30 (at a power level of 80%). Whilst the sample is adequate for the combined sample, it is not so for a gender based analysis. As such, these sex-specific models must be interpreted with caution and further research on a larger, balanced sample is required.

However supplementing the previous examination, this analysis has demonstrated that sex differences should be taken into account when considering the development of strategies. The sexes do not perceive and react to stress in the same way. This has important implications, not just for psychosocial acceleration theory but for wider policy development. If risk factors do not have the same impact on males and females, there is the potential risk of future research, policy and intervention work being misdirected if applied independently of sex.

CHAPTER SIX

General Discussion

6.1. Thesis summary

This thesis evaluated several core tenets of psychosocial acceleration theory, specifically, recent issues concerning the environment, time preference, sex differences and sex-specific pathways (Belsky et al., 1991; Chisholm, 1993; 1999a, Del Guidice, 2009a; Ellis et al., 2009). These elements were incorporated in a process model in an attempt to develop a psychosocial acceleration account of the aetiology of aggressive and reproductive behaviours. In this final chapter, the current body of work will be brought together to discuss its implications for psychosocial acceleration theory. Some of the key limitations, theoretical challenges and implications of the research will also be discussed.

6.1.1. The nature of environmental stress

Papers Two, Three and Seven, detailed the potential constituents of local developmental environments. Across three samples and two levels of analysis, data suggested that sex ratios, population densities, concentrations of youths, high mortality, lower education and poorer socioeconomic circumstances foster higher levels of violent crime, aggression, teenage pregnancies and orientation towards short term mating. Whilst several effects were mediated by the family unit (measured either as female lone parenting or general instability) and thus strongly supported the psychosocial acceleration model, the inclusion of conspecific aggression as an indicator of uncertainty ('harshness' in Ellis et al's (2009) taxonomy) and the impact of dense, youthful populations in census-based models suggested that some stressors have direct effects on behaviour (particularly aggression) in a manner consistent with theories of self-sustaining cycles (Dodge, Bates & Pettit, 1990; Perry, 1997). There is evidence in Paper Seven to suggest that female biased sex-ratios also exert direct effects on short-term mating orientation, particularly in males (supporting Barber, 2000b; Guttentag & Secord, 1983). The 'violence begets violence' effect was independent of sex, suggesting that this stressor in particular makes both males and females more likely to resort to aggressive behaviour. Chisholm's (1999a) distinguishes between "Young Male Syndrome" (Wilson & Daly, 1985) and "Young Female Syndrome" (Chisholm, 1999a) suggesting distinctive sex-specific outcomes with males aggressing and pursuing short-term mating opportunities, whilst females attempt to reproduce early, frequently and with multiple partners. However our data suggest that, whilst stress sensitivities are different for males and females, outcomes are largely the same. Both males and females become more aggressive, more impulsive, more orientated towards reward and more reproduction-focussed. Whilst an argument can be made for sexual selection maintaining sex differences in these domains (Campbell, 1999; Wilson & Daly, 1985), with males remaining 'faster' than females, our data indicate that the response across the sexes is very similar. This suggestion however requires more work before firm conclusions can be drawn.

Nonetheless, apparent sex differences in pathways described in Paper Seven are interesting. Whilst previous work has begun to incorporate some sex-specific pathways (see Del Giudice, 2009a; James et al., 2012), this thesis is more inclusive in the number examined. The present data on the effects of environmental

stress on developing individuals shows different environmental antecedents for males and females. As predicted by sexual selection and parental investment theory (Bateman, 1948; Trivers, 1972), males appear more sensitive to population-based indices, suggesting they are tracking the local competition by monitoring the numbers and density of males and females. Females however seem relatively insensitive to these cues, responding only to levels of environmental aggression as immediate threats to mortality.

Given the different adaptive problems faced by males and females, it is not surprising that they should be sensitive to somewhat different environmental stressors (Gangestad & Simpson, 2000; Jackson & Ellis, 2009; James et al, 2012). In data presented here, males appear more sensitive to a greater range of environmental factors than females, specifically, density, youth population and sex ratios. As our data does not disaggregate these conspecific variables by sex (i.e. how many males/females are present, how many males/females are young), it is not possible to reach firm conclusions about what or who is being monitored. Are males tracking other males (monitoring the competition), other females (monitoring mate availability) or both? The picture for females however is less clear, as beyond life expectancy and local violence, there are no other clear effects on family instability. One explanation could be drawn from Campbell's (1999) hypothesis that harm avoidance is a critical determinant in female behavioural expression. Whilst females generally avoid harm to safeguard fitness, increased exposure to danger increases the likelihood of females responding with retaliatory aggression as well as increasing their tendency to focus on short term mating strategies. Alternatively, stressors that were not measured in the current study may contribute to female strategy development. Nutritional availability, pathogenesis, and general health risks are known factors in female reproductive behaviour and strategy (Gangestad & Simpson, 2000; Thiessen, 1994) and may inform their lifespan expectations. These were not measured as part of this work but maybe pertinent, especially considering recent models regarding internal state predictions (Nettle et al., 2013; Rickard et al., 2014). Without further refinement, it is impossible to be more specific regarding the significance of life expectancy measures at this point.

Female, but not male, pubertal onset appeared to be sensitive to potential stressors and the present findings replicate previous studies (James et al., 2012). Most studies of psychosocial acceleration focus exclusively on female reproductive onset (Belsky et al., 2012; Moffitt, Caspi, Belsky & Silva, 1992; Quinlan, 2003). In the present data however, this female pathway was unrelated to family instability and demographic variables, suggesting some other stress indices may be responsible. Whilst past work suggests a key role for family environment in female pubertal timing (Belsky et al., 1991; Belsky et al., 2012; Ellis & Essex, 2007; Moffitt, Caspi, Belsky & Silva, 1992; Quinlan, 2003; Webster et al., 2014), this was not borne out by the present data (discussed later). Future work needs to more clearly specify additional variables that may signal environmental quality and examine distinctive male and female sensitivities to them. Whilst the current study provides a novel window on these issues, the true of extent of sex differences in environmental perception and their impact on future strategy development is far from clear.

The issue of sex differences aside however, the combined results of these studies help to identify which facets of the environment may be driving strategy development. They provide a window on what constitutes stress in the modern environment and how stressors may affect various elements of strategy development. The

data in Chapter Five also showed how the environment may be associated with "time preference", considered next.

6.1.2. The significance of "Time Preference"

One of Chisholm's major contributions to psychosocial acceleration theory was the introduction of a psychological mechanism to mediate allocations in trade-offs: "Time Preference". This construct added a psychological dimension to explain how ecological stressors are translated into future reproductive strategies. Whilst generally underspecified in previous studies, this thesis made some progress in clarifying its nature and how it interacts with both ecological stress and strategy-related behaviour.

Evidence from Chapter Three converged on traits associated with appetitive motivation as best representing "Time Preference". Sensation seeking conformed to all criteria derived from Chisholm's (1999a) specification of this mediating psychological mechanism. It demonstrated clear sex differences, responded to ecological stress and showed significant relationships with pubertal onset, sexual attitudes, age of first reproduction, number of sexual partners and aggressive behaviour. Trait impulsivity however (conceptualised as a failure to deliberate) did demonstrate some of these relationships and thus was included in the research described in Chapter Five. Both traits appeared to respond to environmental stress and may potentially mediate the relationship between stress and strategy behaviour. In Paper Seven (Figure 12), it was found that the effects of impulsivity were less widespread than sensation seeking and limited to aggressive behaviour, thus strengthening the proposal that sensation seeking (or some synonymous form of reward seeking) is the closest trait embodiment of "Time Preference".

Chisholm (1999a) conceptualised "Time Perspective" as a combination of two mechanisms: a future detector and a value detector. The future detector is a higher-order cognitive process, explicitly representing stress embodied through development. Its lower-order counterpart, the value detector, is an evolutionary ancient, implicit process designed to quickly evaluate situations. These systems together are expressed through "intertemporal choice [between alternatives with varying costs or benefits over time], impatience, impulsiveness, self-control and the inability to defer gratification" (Chisholm 1999a, p.135). Whilst Chisholm's description of how this mechanism is represented in the brain was vague, this combination of higher and lower-order processes is consistent with contemporary dual process models of cognition (Carver, 2005). Below, a theoretical account of how sensation seeking and impulsivity may jointly foster adaptive life history strategies is suggested.

6.1.2.1. Dual Process Theory

Dual process models of personality in psychology emphasise two distinct processes underlying behaviour. Response to stimuli can be automatic (implicit) or intentional (explicit). Explicit processes are higher-order in nature and are cognitively 'cooler'. They are represented in executive functioning and are predominantly conscious, effortful, slow, controllable, and have been localised to dorsolateral prefrontal regions of the brain (MacDonald, 2008; Stanovich, 2004; Zelazo & Cunningham, 2007). Implicit processes are evolutionarily ancient systems that underlie reactions to stimuli. They are fast, reflexive, unconscious, effortless,

affective (or 'hot') and rooted within the dopaminergic circuitry of the brain, although the left and right anterior cortex have also been implicated (MacDonald, 2008; Sutton & Davidson, 1997; Zelazo & Cunningham, 2007). Having two systems to deal with environmental stimuli is important to social organisms such as humans. Social living entails explicit and rational deliberation (Trivers, 1985), such as whether to cooperate with others, assist in communal foraging or negotiate a marriage alliance. These are not trivial decisions; costs and benefits must be balanced to ensure the best fitness returns. By contrast, a threat (a tiger, a group of armed men) fosters a more immediate action (implicit, automatic responses) because hesitation may result in injury or death (favouring 'better safe than sorry' responses; Gilbert, 1998). These two forms of processing are adaptive under different circumstances.

6.1.2.2. Socioaffective control

Dual process theory suggests that lower-level, implicit processes split into two distinct systems: the Behavioural Inhibition System (BIS) and Behavioural Approach System (BAS – Gray, 1970, 1982). BAS is reward-sensitive, creating positive affect and fostering approach behaviour. BIS is punishment-sensitive, generating negative affective and regulating withdrawal behaviour. Sensitivities between these systems regulate variation in approach-avoidance behaviour. Whilst variations of the dual process model exist (see Carver, 2005) most emphasise the functional independence of approach and avoidance systems.

A third system has been hypothesised to regulate these lower-level systems; affective control (Carver, 2005; MacDonald, 2008). The affective control system countermands affective, prepotent responses when necessary. It may suppress impulses even when BAS outweighs BIS, but equally may override withdrawal tendencies when BIS outweighs BAS (Carver & Scheier, 1998). Affective control moderates socio-affective behavior, inhibiting lower-level activity via serotonin circuitry (Carver, 2005). This inhibitory control differs from executive function inhibition which manages affect-neutral, explicit cognitive processing and planning (Evans, 2008; MacDonald, 2008). MacDonald reviews neurological evidence to suggest the functional independence of affective and executive control, the former occupying substrates of the orbitofrontal and ventromedial frontal cortex, the latter localised predominantly to dorsolateral prefrontal areas. The former modulate affectively "hot" processes and the latter cognitively "cold" processes (Zelazo & Cunningham, 2007).

Traits examined in Papers Five and Six represent aspects of this processing system. Sensation seeking is thought to represent implicit processing (autonomic, fast, affective and effortless), is related to systems governing lower-level motivational factors based on evolutionarily older mechanisms and is thought to reflect BAS hypersensitivity mediated by the dopaminergic architecture of the brain (Zuckerman & Kuhlman, 2000). Impulsivity represents a failure of the affective control system: the failure to override a prepotent response in socio-affective situations. Unlike sensation seeking, which is lower level and BAS driven, this construct represents a "hot" and reflexive form of control (distinct from explicit 'cold' executive functioning), regulated by substrates of the orbitofrontal and ventromedial cortices (MacDonald, 2008) and is also sensitive to modulation by the dopaminergic system (see Congdon & Canli, 2008, for a review).

Why should lower-level "hot" systems be more relevant to strategy development than "cold" systems? Evidence supports links between socio-affective regulation and life history behaviour. Higher sensation seekers

(i.e., overactive BAS) are likely to positively appraise risks, take sexual and criminal risks more frequently (Horvath and Zuckerman, 1993) and to be less sensitive to threatening stimuli (Raine, Reynolds, Venables, Mednick and Farrington, 1998). They are more likely to seek variety in sexual experiences across more sexual partners (Zuckerman, Tushup and Finner, 1976) and to engage in antisocial behaviour (Perez and Torrubia, 1985). Sensation seeking is higher in individuals (both men and women) who have committed a greater number of criminal behaviors (Farley and Farley, 1972; Farley, 1973). Impulsivity demonstrates a similar pattern of results (McAlister, Pachana, and Jackson, 2005; Vigil-Colet and Codorniu-Raga, 2004). Whilst long-term planning, rationality and logic are doubtlessly important in determining lifestyles, it is likely that consistently uncertain and unpredictable environments make long-term goals increasingly difficult to plan and implement, thus automatic, implicit responses are more likely to foster fitness benefits. The lower-level BAS evolved in our own and other species because of its benefits in terms of survival and reproduction. These fundamental evolutionary adaptations ensure a degree of rapid response to threat and to sexual opportunities. In unpredictable or competitive situations, inactivity is likely to incur greater fitness costs than reactivity. Error management theory (Haselton and Buss, 2000) proposes that, in evolutionary terms, failure to respond to immediate threats or opportunities (false negative) is a more serious error than responding to misidentified threats or opportunities (false positive). At a psychological level, failing to take advantage of opportunity (inaction) is regretted more strongly than action (Beike, Markman, and Karadoagn, 2008). Responding to critical scenarios in the face of uncertainty, faster "hotter" processes will take precedence in order to avert death and enhance sexual success. As uncertainty increases and the expectation of survival lowers, a propensity to react quickly and to seize opportunities is advantageous.

The regulation of aggression and sexual behaviour via affective control is important also, as indicated by the significance of impulsivity. Whilst it is tempting to assume that BAS activation on its own is adaptive (Duntley & Buss, 2004), MacDonald (2008) argues that the evolution of affective control was advantageous in moderating 'automatic' responses to complex survival situations. Unconstrained aggression and reward-seeking behaviour, dependent solely on reflexive reactions, would risk high potential costs. Reacting with violence to every insult or seizing every reproductive opportunity without restraint would not be adaptive in light of punishments and reprisals that could ensue. Affective control therefore evolved to moderate these responses. The weaker this control mechanism, the more reflexive aggressive and sexual behaviours become. Our data suggest that risky sexual and aggressive responses result from both an oversensitivity to reward (high sensation seeking) and a failure of socio-effective control (impulsivity).

To conclude this section, it appears that environmental stressors can potentially lead to a developmental trajectory emphasising short-term consumption and faster responses to threats and opportunities in the environment, consistent with the theorising of Chisholm (1999a). A combination of a strong BAS and a socio-affective system calibrated to risky environments make the emergence of aggression and sexual precocity more likely and thus are potentially a critical mechanism in the development of life history strategies.

6.2. General limitations and challenges

Having shown that psychosocial acceleration theory is broadly supported by the studies in this thesis, some of the general limitations and challenges to this perspective as a whole will now be considered. Some issues raised below have been touched upon briefly in commentaries in previous chapters.

6.2.1. Genetic effects

Despite the evolutionary perspective of this thesis, the critical role of genes has been ignored despite research that consistently demonstrates that aggression, reproductive behaviours, impulsivity and sensation seeking have a heritable basis (Baker, Jacobsen, Raine, Lozano & Bezdjian, 2007; Bouchard, 2004; Caspi et al., 2002; Gangestad & Simpson, 1990; Kaprio, Rimpela, Winter, Viken, Rimplela & Rose, 1995; Koopmans, Boomsma, Heath & van Doornen, 1995; Munafo, Yalcin, Willis-Owne & Flint, 2008; Reif et al, 2011; Rhee & Waldman, 2007; Rowe, 1996; 2002). As explored in Chapter Two, proponents of Differential-K theory even emphasise the heritability of entire strategies (Figueredo et al., 2004, 2005). Proponents of psychosocial acceleration theory do not completely ignore genetic factors, but they attach greater significance to how phenotypes develop to be adaptive. Psychosocial acceleration theory (Belsky et al., 1991) focussed on rearing quality as the key predictor of reproductive strategies, particularly on pubertal timing as a product of familial stress. Belsky (2012) reviewed genetic evidence for the heritability of puberty and noted inconsistencies in the literature, particularly a lack of replicability. Belsky et al. (1997; 2000; 2012; Belsky, Bakermans-Kranenburg & van IJzendoorn, 2007; Belsky & Pleuss, 2009; Pleuss & Belsky, 2013) instead argued that life history theory encompasses gene-environmental interactions in the form of alternative and conditional reproductive strategies (Belsky, 2000). Evidence from natural experiments demonstrates that rearing and heredity interact to determine pubertal timing (in females at least). Chasiotis, Scheffer, Restemeier and Keller, (1998) examined mother-daughter dyads in West Germany and dyads from Eastern Germany after the fall of the East German Republic. Whilst age of menarche in the mother was a strong predictor of menarche of daughters in West German dyads, this was not the case in East German dyads. In East German dyads, mother's age of menarche was not predictive of daughters' age of menarche. Chasiotis et al. concluded that changes in environmental stability experienced by East German mothers (who had themselves developed in a climate of economic consistency) had a greater impact upon their daughters' development than genetic effects from their mothers, and that the new and unpredictable economic situation accelerated pubertal development. In West German dyads, daughters inherited not just their mother's genes but also their developmental environment. The role of the environment in reproductive strategies is therefore compelling.

Life history theory emphasises mechanisms of developmental plasticity (discussed briefly in Chapter Three) that are sensitive to local conditions. Belsky's work suggests that phenotypic plasticity could be a genetic trait in its own right, allowing some individuals to adapt to changing environments and others to be relatively unresponsive to conditions, developing along a highly canalized pathway (Belsky et al., 2007). Furthermore, Belsky (2005) claimed that this perspective may also partially explain the consistent finding of low shared environmental influences but high non-shared environmental influences in behavioural genetics studies (Plomin & Daniels, 1987), as siblings may respond differently to identical local environments depending on their

potential for plasticity. Evidence for differential susceptibility to environmental factors is extensive and will not be reviewed here (see Belsky, 2005; Belsky & Pleuss, 2013). This perspective on gene-environment interactions is still comparatively recent and further work is required although some recent theoretical models detail how differential susceptibility could emerge (Del Giudice, 2014b; Del Giudice, Ellis, Hinnant & El-Sheikh, 2012; Frankenhuis & Panchanathan, 2011). However, it is clear that the crucial role of the genotype is no longer being ignored. Whilst there is undoubtedly a case for genetic influence, its omission from consideration in this thesis is simply because the research designs used could not dissociate genetic and environmental effects (see Belsky et al., 2007; Belsky & Pleuss, 2013 for suggestions on design criteria). Future work should aim to incorporate genetic factors to add another dimension to the study of psychosocial acceleration theory, although it should be noted that this is no small task.

6.2.2. The role of culture

The role of culture has been largely ignored in this thesis, as it has in life history research more generally. Contemporary cultural evolution models emphasise how culturally-acquired information can impact upon aspects of evolved biology, cognition and behaviour and that culturally-transmitted learning was essential for survival across varying ecological niches (Boyd, Richerson & Henrich, 2011; Henrich & McElreath, 2007). For example, genes regulating lactose tolerance beyond weaning have fixated in populations where animal husbandry and dairy practices are culturally normative due to the nutritional benefits lactose brings (Durham, 1991). Whilst the capacity for culture has evolved through natural selection in modern hominids, this same construct now impacts upon our ongoing evolution. Niche construction theory posits that organisms (humans in particular) are adept at manipulating their environments (Laland, 2007; Odling-Smee, Laland & Feldman, 2003). Evolution is driven by the environment but environments are also manipulated by organisms that evolve within them, making genetic and cultural transmission inextricably entwined. Niche construction can be seen as an evolutionary process in its own right. Laland (2007) also suggests that because niche construction through cultural transmission is likely self-reinforcing, the power of cultural transmission is further enhanced. As yet, most work in this field consists of mathematical simulations but if these principles are as powerful as has been suggested, their impact on strategy development must be examined. The complexity of genetic and cultural interactions however make it difficult to study, particularly as any form of shared learning can be broadly defined as 'cultural' (Plotkin, 2007).

Life history strategies are doubtless informed by cultural factors. Slow development in hominids allows time for learning, even in domains as evolutionarily ancient as reproductive and aggressive behaviours. Cultural norms help regulate reproductive behaviour and targets of aggressive behaviour within society. The multiple theatres inhabited by a developing individual (such as the family, peer groups, school etc.) will all exert some impact upon development. Peers form an individual's future pool of mates and competitors, so that learning from peers as well as parents ensures that growing individuals are adjusted to their generational cohort (Henrich & Broesch, 2011; Kline, Boyd & Henrich, 2013). Dishion, Ha and Veronneau (2012) emphasise that deviant peer clustering is an important, often overlooked, factor in life history strategy development. Such clusters no doubt reinforce behavioural patterns such as aggression and sexual promiscuity. A novel experiment by McElreath et al. (2005) saw participants facing economic choices under conditions where outcomes varied and

environments fluctuated. The experimenters found that when outcome variance was high, participants were more likely to be influenced by the decisions of other participants (greater conformity). However, increasingly fluctuating environments decreased the likelihood of imitation (lower conformity). As these two conditions are synonymous with Ellis et al's (2009) harshness (high outcome variance) and unpredictability (high environmental fluctuation) dimensions, one must consider how cultural learning may vary in such circumstances and how it may impact upon strategy development. It may be that strategies forming under conditions of increasing harshness entail greater conformity and imitative learning, whilst unpredictable environments foster the opposite trend. In support of this, Dishion et al. (2012) found that deviant peer clustering (group conformity) increased under conditions associated with increasing harshness. Whilst life history research has generally neglected culture, such influences on strategy choice should be an important future avenue of research.

6.2.3. Measuring family instability and pubertal onset

Issues with the relationship between family instability, pubertal timing and their respective measurements have been raised throughout this thesis. Limitations in their measurement require discussion because Belsky et al's (1991) original work on predictors of early puberty has been a cornerstone of psychosocial acceleration theory. Several issues are worthy of consideration.

First, Paper Seven suggested that family instability predicted sensation seeking which in turn predicted pubertal onset. Examination by gender revealed that this relationship appeared only in females. Correlations between family instability and puberty were effectively zero. This is contrary to past research (Belsky, et al., 2007; 2010; Ellis, 2004; Ellis & Garber, 2000; Ellis, McFayden-Ketchum, Dodge, Petit & Bates, 1999; Moffitt, Caspi, Belsky & Silva, 1992; Quinlan, 2003). The failure to replicate past results may have been a result of our measurement of pubertal onset. Alternatively, it may be that different aspects of family functioning or structure are more or less sensitive at detecting this relationship. Given the focus of previous literature, father absence may be one such factor (Ellis, 2004) and stepfather presence may be another (Draper & Harpending, 1982; Ellis, 2004; Ellis et al., 2003). These were not measured specifically in this study and may explain why this association was not found.

A second related issue pertains to the use of retrospective measures of family instability. Belsky et al., (1991) and later theorists claim that the critical period in which stress has its effects is the first five to seven years of life. Quinlan (2003), in a large national study of 10,000 women found that instability (parental divorce or separation) during the first five years of life better predicted earlier menarche than the same factors at ages six to eleven. As our studies examined teenagers and adults, and did not measure family instability in the first seven years of life, this may account for the weakened association with pubertal age. Additionally, pubertal age is sensitive to the number of years of recorded father absence (Ellis & Garber, 2000; Moffitt, Caspi, Belsky & Silva, 1992), and a failure to measure stressor duration may also have weakened the current findings. These timing issues combined with the narrowness of the family instability measure may (uniquely or additively) account for why the expected relationship between pubertal onset and family instability was not found.

A third issue is the fact that, in Chapter Five, early pubertal onset was not predicted in the male model, whereas it did feature in the female model (Figures 13 and 14). Paper One also illustrated significant effects of

environmental stressors on female but not male pubertal onset. Whilst proponents of psychosocial acceleration theory focus chiefly on females, there is some evidence to suggest that factors (such as father absence) can accelerate pubertal onset and reproductive behaviours in males also (Bogeart, 2005; Kim, Smith & Palermiti, 1997; but see Sheppard & Sear, 2011). Our findings did not corroborate this (perhaps for the reasons outlined above). In Paper One, environmental and social factors had no effect on pubertal onset in men (although only a few HKSS items focus on family and kin), and again in Chapter Five the relationship between family instability and puberty in males was effectively zero. Whilst weak but significant correlations between sources of environmental stress (conspecific violence) and puberty emerged in the predicted direction for males, these effects were eliminated when modelled (see Chapter Five). Male pubertal timing is worthy of further study particularly using more sensitive measures of family functioning in younger males (particularly in the critical first seven years). Currently, our work supports research that has found little support for links between stressors and puberty in males (Belsky et al., 2007; James et al., 2012).

Measurement issues have been highlighted as a key limitation that may explain the inconsistent findings regarding puberty in this thesis. The measures were self-reported and retrospective which rely on accurate memory of the initial signs of puberty. Whilst menstrual onset is a milestone that is likely to be recalled by women, the onset of male secondary sexual characteristics is harder to pinpoint (James et al., 2012). However, a longitudinal study using yearly observations to track pubertal development, (Belsky et al., 2007) found that rearing experience had no effect on male pubertal onset, but significant effects on female pubertal onset, suggesting that the sex difference in the relationship between rearing experience and pubertal onset may not be an artefact of retrospective measurement. However, these assessments were annual and thus calibrated in years. As Ellis (2004) points out, rearing influences are likely to delay or accelerate puberty with an order of magnitude of months (as short as three or four), rather than years. The extent to which measurement issues obscure significant effects for males remains unresolved.

Theorists use sexual selection theory to suggest that male and female reproductive strategies are different, with females being relatively more sensitive to family circumstances and males to peer experiences (Del Giudice, 2009a; Del Giudice, Ellis & Shirtcliffe, 2011, James et al., 2012). However an explanation of why pubertal onset is not accelerated by environmental stressors in males has not been made explicit. The conclusions from the present studies are mixed and more experimental work is required before we can confirm or refute this apparent sex difference in the correlates of pubertal timing.

6.3. Competing evolutionary theories

Throughout this thesis, evolutionary proposals that present some theoretical challenges to psychosocial acceleration theory have been briefly referred to. Whilst these are mainly variations of psychosocial acceleration theory, their differences should be noted.

The internal state model (Nettle, Frankenhuis & Rickard, 2013; Rickard, Frankenhuis & Nettle, 2014) offers internal cues to mortality as a potential alternative to environmental stressors. Although internal mortality cues have only recently been discussed in relation to life history strategies and direct tests of this proposal are still awaited, cues associated with internal mortality (such as pathogenesis) are implicated in reproductive

behaviours (Mishra & Lalumière, 2008; Schaller & Murray, 2008; Thornhill & Fincher, 2011) and the onset of conditional reproductive strategies (see Gangestad & Simpson, 2000). Belsky (2014) notes that this perspective is not entirely incompatible with psychosocial acceleration theory. Also, Del Giudice (2014a) challenges the mathematical models used by Nettle et al. (2013). However, the incorporation of internal mortality cues to life history models may prove valuable with recent theoretical works further developing this perspective (Del Giudice & Ellis, in press).

The original Belsky et al. (1991) model was an adaptation of paternal investment theory (Draper & Harpending, 1982) but the special significance of the role of the father is less evident in psychosocial acceleration theory, where it is relegated to the role of a 'stressor'. However, many researchers still emphasise the significant impact that fathers play in delaying or accelerating puberty, particularly in girls (Bereckei & Csanaky, 1996; Ellis, 2004; Ellis, McFayden-Ketchum, Dodge, Pettit & Bates, 1999; Sheppard, Garcia & Sear, 2014). Firm conclusions are hampered by studies confounding the effects of father absence with other familial stressors (such as step father presence or absence, maternal depressive symptomology, family conflict etc.), making the unique effect of father absence difficult to establish. Whilst Papers Two and Three of this thesis used measures of female lone parenting and supported the father absence literature, actual paternal involvement and investment was not measured or controlled for. A prospective study by Ellis, et al., (1999) that measured a range of family factors found that the quality of fathers' relationships with developing daughters was the most significant familial factor in explaining variance in pubertal onset. Although the debate is ongoing, the emergence of a special place for the father in influencing pubertal age does not significantly undermine the core principles of psychosocial acceleration theory even if it suggests that some of the familial stressors proposed by Belsky et al., (1991) have a greater impact than others. In this sense, paternal investment theory is largely complementary, not contradictory, to psychosocial acceleration theory.

Ellis (2004) also suggested a further alternative based on psychosocial acceleration theory that reconceptualised the role of puberty: child development theory. In traditional psychosocial acceleration theory, pubertal onset is viewed as responsive to early stressors and determines future reproductive schedules. Earlier puberty is probabilistically linked to earlier sex, more frequent copulations with more partners, increased sociosexuality, and higher aggression. Child development theory, whilst sharing the idea that pubertal onset is linked to childhood experience, does not make claims regarding later sexual behaviour. In Ellis's conceptualization, whilst puberty is linked to earlier reproductive onset (by virtue of the fact that these events are sequential), adopting a mating over a parenting strategy does not necessarily follow. Ellis claimed that pubertal onset marks the beginning of reproductive onset and a shift from reliance on parental investment to reliance on peer and sexual relationships. Children growing up in high quality environments benefit from taking time to mature and pubertal onset is contingently delayed to make maximum use of it. This proposal (though largely unexplored empirically) makes no prediction about future investment in mating versus parenting, only about the timing of reproductive onset. Thus it allows actual reproductive behaviour to be shaped by factors beyond early childhood stressors that occur closer to the time of actual reproduction (although factors that determine these later reproductive decisions are not specified). This idea answers critics of strategy canalization based solely on childhood experience (Rowe, 2000) who argue that predicting future conditions for reproduction

based on current childhood conditions is inherently risky. Secondly, it also explains why many studies which show a key association between pubertal age and onset of sexual activity, often fail to show associations between reproductive onset and number of sexual partners, as the model makes no predictions about the latter. The evidence presented in this thesis provides mixed support for Ellis' model. Paper One demonstrated a significant association between pubertal onset and number of sexual partners (supporting the traditional approach), whereas Paper Five did not (supporting Ellis, 2004). However both show the significant relationship between pubertal onset and onset of sexual activity as predicted by both models. Paper Seven also shows weak, mainly non-significant associations between pubertal onset, aggression and positive attitudes to short-term sexual relationships. Thus, while our data support the proposals of Belsky et al., (1991) and Chisholm (1999a), they cannot falsify the alternative proposal by Ellis. However, as with paternal investment theory, this model is grounded in the core tenets of psychosocial acceleration theory and provides challenges only to the latter elements of the model, not the earlier processes (i.e. environmental stress, family instability, "time preference" and pubertal onset).

Perhaps the most comprehensive of recent models of life history is Biological Sensitivity to Context (BSC - Boyce & Ellis, 2005; Ellis, Essex & Boyce, 2005) and its later version, the Adaptive Calibration Model (ACM –Del, Giudice, 2014b; Del Giudice, Ellis & Shirtcliff, 2010; Del Giudice, Hinnant, Ellis & El-Sheikh, 2012; Del Giudice & Ellis, in press). These models are based on the stress response system as an adaptive mechanism which matches physiology and behaviour to the ecological niche of developing individuals. In early development (the first two years in particular), activation of the stress system (the sympathetic and parasympathetic components of the autonomic nervous system and the hypothalamic pituitary axis) create differential susceptibilities to stressors. This early pattern of activation incorporates information about the harshness and unpredictability of the environment and manifests in later patterns of stress responsivity. Del Giudice and colleagues identify four distinct patterns of stress responsivity (which will not be discussed here) that emerge from early stress exposure, each predicting a different suite of life history behaviours and outcomes. Early activation of the stress system interacts with genes regulating differential susceptibility to environments (plasticity; see earlier discussion) to shift developing individuals towards different developmental trajectories based on their stress responsivity. This in turn leads to individual differences in life history strategy and later stress responses across development. The system adaptively adjusts to changing environmental circumstances, biological developmental and hormonal levels at various transitional stages (childhood › middle-childhood › adolescence › early adulthood) and is used to explain key sex differences in reproductive goals. This model also integrates more recent research on biological factors in strategy development, including internal states. Whilst relatively recent, there is promising empirical support for ACM (Del Giudice et al., 2012). ACM can be seen as an expansion of psychosocial acceleration theory rather than a competing perspective. BSC and ACM, although more complex, are both compatible with Belsky's (2000) proposals of differential susceptibility to context. Furthermore, despite the level of detail and complexity regarding interactions between the stress system, phenotypic plasticity and life history variables, early psychosocial acceleration theorists (Belsky et al., 1991, Chisholm, 1999a; Chisholm et al., 2005) also briefly explored the psychoneuroendocrinology of early stress exposure, with particular emphasis on the hypothalamic pituitary axis. The compatibility between ACM and

psychosocial acceleration theory suggests that integration of the two models will greatly enhance our understanding of the development of life history strategies.

6.4. Implications for future research

The current body of work, whilst endeavouring to evaluate psychosocial acceleration theory, is foundational and only scratches the surface of this broad, multifaceted perspective. Several major points for future research are discussed briefly below.

From the analysis of environmental cues in Papers Two, Three and Seven, it is clear that a simple linear process (environment › family › 'time preference' › behaviour) is not viable. The multivariate and interactive nature of the effects clearly suggests a complex series of pathways that can lead to the onset of 'faster' reproductive strategies. However, greater consideration of the nature of stress is still required. The number of potential stressors (not measured in this thesis) that may explain substantial portions of variance are many. These may include ethnic and racial stratifications, access to opportunities, pollution and quality of dwellings to mention but a few. Given the recent emphasis on internal state theory (Nettle et al., 2013; Rickard et al., 2014), a combined consideration of factors such as general health, pathogenesis and related variables should also be a key goal in future work. An assessment inventory of local environments that can be reliably administered to individuals to evaluate stress exposure is needed. As noted in Chapter Three, this is no easy task (Nicotera, 2007) but it is a worthwhile research objective. In a similar vein, measures of family stress also need to be more comprehensive in order to establish which factors (such as father absence) carry greater weight in the onset of aggressive and reproductive behaviours.

Sampling also needs to be considered more carefully in future life history research. To date, most studies (including this one) have focused predominantly on 'normative populations'. Whilst informative in examining variation within the normal range of behaviour, families in high-risk settings have been under-represented. This is troubling, not least because these individuals represent the extremes of strategic possibilities and environmental stressors (Ellis et al., 2009). For the purposes of intervention and the validation of key life history principles, sampling from a greater range of families that capture the full spectrum of stress and uncertainty should be a research imperative.

As mentioned earlier, inconsistencies in conceptualizations of 'time preference' traits such as 'impulsivity' have been a hindrance to the study of this important aspect of psychosocial acceleration theory (and personality as a whole). The wide and varied range of concepts and measures of impulsivity (Depue & Collins, 1999; Evenden, 1999) makes it difficult to effectively integrate results from different studies. If the validity of the assertions made in this thesis (and in psychosocial acceleration in general) are to be tested, some form of consensus is essential regarding what psychological mediator should be measured. Without such an undertaking, future work is likely to continue advancing ever newer 'impulsivity' or 'time preference' conceptualizations that further conflate an already confounded area of personality psychology.

A final point for consideration is the design of future studies. Historically, research has mainly used cross-sectional data and correlational designs examining small causal pathways that are embedded within the

overall model of psychosocial acceleration theory. Whilst this work has been useful in establishing the core tenets of the theory and validating some of its claims, the number of such confirmatory studies has reached a point where the added value of further studies is limited. To substantially advance this field, well-designed and tightly-operationalized prospective studies are needed. Whilst difficult, expensive and time consuming, such studies are invaluable in affording greater clarity about developmental pathways, and can mitigate many of the shortcomings of current studies (including the studies in this thesis). To properly evaluate an evolutionary theory of development, we must begin to more accurately examine development itself.

6.5. Summary and Conclusions

In conclusion, the current body of work presented in this thesis is generally supportive of Belsky, et al's (1991) psychosocial acceleration theory as a useful evolutionary model of child and adolescent development. The findings throughout this thesis support almost all of the key propositions in the original theory and its later developments by Chisholm (1993; 1999a) and Del Giudice (2009a). Data suggest that the family, despite its importance, is not the only factor involved in determining aggressive and reproductive behaviours. Whilst this does not directly contradict psychosocial acceleration theory, it suggests that future studies should pay greater attention to the wider ecological context. The role of 'time preference' was also evaluated against several evolutionary-derived criteria following Chisholm (1999a). Sensation seeking and impulsivity were identified as likely trait representations of Chisholm's psychological mechanism of time preference. The adoption of a dual process model allows psychological mediators to be integrated with recent research on the neural architecture of personality and helps to explain why these traits serve a critical adaptive function. The research reported in this thesis has attempted to elaborate on the nature of stress and uncertainty in rearing environments, clarified the role of 'time preference' and attempted to demonstrate where biological sex fits into the model, yet the foundational nature of this work must be stressed. Psychosocial acceleration theory (and life history in general) is a meta-theory of development. It is hoped that the research reported here can inform more comprehensive studies of the key features of evolutionary developmental theorists in the future. It may also have relevance for future policy intervention (Ellis et al., 2012). Rather than being irrational or pathological, aggression and sexual precocity may be adaptive for developing individuals in uncertain circumstances despite their negative societal perception. However, only by understanding the processes behind strategy canalization can we hope to target interventions to reduce the stress and inequalities that parents and developing youngsters face in their environment (Chisholm, 1999a; Chisholm & Burbank, 2001).

Appendix 1: Standardised regression weights for the modified model over three samples

			Restricted (N=169)	Validated (N=170)	Whole (N=339)
Father Absence	<	Education	-0.14*	-0.19**	-.16**
Father Absence	<	Population Density	0.20**	0.28**	.24**
Father Absence	<	Unemployment	0.39**	0.22**	.31**
Father Absence	<	Youth Sex Ratio	-0.10*	-0.17**	-.13**
Father Absence	<	Life Expectancy	-0.30**	-0.31**	-.31**
Strategy	<	Father Absence	0.24**	0.30**	.28**
Strategy	<	Education	-0.45**	-0.44**	-.44**
Strategy	<	Life Expectancy	-0.37**	-0.31**	-.34**
Conception Rate	<	Strategy	0.92**	0.92**	.92**
Violence	<	Strategy	0.41**	0.40**	.40**
Violence	<	Population Density	0.28**	0.33**	.31**
Violence	<	Youths	0.21*	0.16*	.18**

Note,*p<.05, **p<.001

Appendix 2: List of all effect sizes included in the analysis by study, category and domain.

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	3
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	15
Acheson et al (2007)	B	0_a		10	10	4	1	0	1	1	39
Aklin et al (2005)	B	0.22		26	25	1	1	0	1	1	3
Aklin et al (2005)	B	0.20		26	25	1	1	0	1	1	27
Allen et al (1998)	B	0_a		16	10	4	1	0	1	1	15
Baker et al (2003)	B	-0.31		51	39	5	1	0	1	1	15
Bare (2006)	B	-0.41		41	51	4	1	0	0	0	3
Bare (2006)	B	0.24		41	51	4	1	0	0	0	3
Berlin et al (2005)	B	0.61	2.21	10	29	6	0	0	1	1	38
Berlin et al (2005)	B	0.03	1.51	10	29	6	0	0	1	1	38
Berlin et al (2005)	B	-0.34	0.60	10	29	6	0	0	1	1	38
Berlin et al (2005)	B	-0.11	0.47	10	29	6	0	0	1	1	38
Bjork et al (2004)	B	0.32		27	14	5	1	0	1	1	15
Brown et al (2006)	B	0_a		21	37	6	0	0	1	1	39
Casillas (2006)	B	0.26		84	125	4	1	0	1	0	27
Casillas (2006)	B	-0.35		84	125	4	1	0	1	0	38
Casillas (2006)	B	-0.47		84	125	4	1	0	1	0	39
Casillas (2006)	B	-0.04		84	125	4	1	0	1	0	39
Casillas (2006)	B	-0.24		84	125	4	1	0	1	0	39
Clark et al (2005)	B	-0.20	2.97	27	13	4	1	1	1	1	39
Clark et al (2005)	B	-0.16	0.12	27	13	4	1	1	1	1	39

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Davis et al (2007)	B	0_a		81	164	5	0	0	1	1	27
de Wit et al (2007)	B	-0.21	1.41	303	303	6	0	0	1	1	15
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	15
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	15
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	39
de Wit et al (2002)	B	0_a		18	18	4	0	0	2	1	39
Enticott et al (2006)	B	0.56	2.82	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	-0.36	0.67	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	-0.17	0.62	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	0.24	1.89	14	17	5	1	1	1	1	39
Enticott et al (2006)	B	-0.11	1.00	14	17	5	1	1	1	1	39
Epstein, Erkanli, et al (2003)	B	0.66	0.97	84	94	1	1	0	3	1	39
Epstein, Erkanli, et al (2003)	B	0.64	0.72	98	97	2	1	0	3	1	39
Epstein, Erkanli, et al (2003)	B	0.76	0.67	115	89	1	1	0	3	1	39
Epstein, Richards, et al (2003)	B	0.11		32	46	5	1	0	1	1	15
Epstein, Richards, et al (2003)	B	0.31		32	46	5	1	0	1	1	15
Feldman (1999)	B	-0.47		92	108	3	1	0	0	0	38
Feldman (1999)	B	-0.44		92	108	3	1	0	0	0	38
Feldman (1999)	B	0		92	108	3	1	0	0	0	38
Feldman (1999)	B	0		92	108	3	1	0	0	0	39
Gargallo (1993)	B	0.06	1.07	107	94	1	1	1	3	1	38
Gargallo (1993)	B	0	0.82	107	94	1	1	1	3	1	38
Goudriaan et al (2007)	B	0_a		100	100	3	0	0	0	1	27

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Heerey et al (2007)	B	-0.60	0.69	12	17	6	0	1	1	1	15
Herba et al (2006)	B	-0.47	1.32	29	28	2	0	1	3	1	39
Herba et al (2006)	B	0.07	0.66	29	28	2	0	1	3	1	39
Herba et al (2006)	B	-0.08	0.39	29	28	2	0	1	3	1	39
Herba et al (2006)	B	-0.06	1.78	28	28	2	0	1	3	1	39
Herba et al (2006)	B	0.22	1.42	28	28	2	0	1	3	1	39
Hunt et al (2005)	B	0.52	1.23	22	58	3	0	0	0	1	3
Johnson et al (2007)	B	-0.10	1.65	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.66	1.63	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	-0.04	1.28	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.71	1.19	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.41	1.07	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	0.24	0.98	17	13	4	1	0	1	1	15
Johnson et al (2007)	B	-0.23	0.81	17	13	5	1	0	1	1	15
Johnson et al (2007)	B	-0.14	0.38	17	13	4	1	0	1	1	15
Johnson et al (2007)	B	-0.37	0.29	17	13	4	1	0	1	1	15
Jollant et al (2005)	B	0_a		41	41	0	1	1	1	1	27
Keilp et al (2005)	B	0_a		21	37	5	1	0	1	1	39
Kirby & Petry (2004)	B	0.02	1.27	33	27	5	1	0	1	1	15
Kirby et al (2002)	B	-0.23		72.5	72.5	0	1	0	1	1	15
Kirby et al (2002)	B	-0.16		72.5	72.5	0	1	0	1	1	15
Kirby et al (2002)	B	-0.17		73	81	3	1	0	0	1	15
Kollins (2003)	B	0_a		14	28	3	1	0	0	1	15
Lejuez et al (2002)	B	0.63		43	43	3	1	0	1	1	3

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Lejuez et al (2003)	B	0.47		30	30	3	1	0	0	1	3
Lejuez et al (2003)	B	0.49		30	30	3	1	0	0	1	3
Lejuez et al (2003)	B	0.68		30	30	3	1	0	0	1	3
Lejuez et al (2003)	B	-0.72		30	30	3	1	0	0	1	27
Lejuez et al (2003)	B	-0.68		30	30	3	1	0	0	1	27
Lejuez et al (2003)	B	-0.49		30	30	3	1	0	0	1	27
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Leshem & Glicksohn (2007)	B	0_a		59	123	0	1	2	3	1	38
Maras et al (2006)	B	0.64		29	27	1	0	1	3	1	3
Marczinski et al (2007)	B	0_a		16	16	4	0	0	0	1	39
Mcleish & Oxoby (2007)	B	-0.43	1.16	50	32	3	0	0	0	1	15
Mcleish & Oxoby (2007)	B	-0.59	0.77	50	32	3	0	0	0	1	15
Mcleish & Oxoby (2007)	B	0.14	0.59	50	32	3	0	0	0	1	15
Overman et al (2004)	B	0.35		240	240	0	1	0	2	1	27
Paaver et al (2007)	B	-0.07	1.35	222	261	2	0	1	1	1	38
Petry et al (2002)	B	0.61		32	32	4	0	0	1	1	15
Quiroga et al (2007)	B	0.02		984	668	4	0	1	1	1	38
Quiroga et al (2007)	B	-0.79	0.48	984	668	4	0	1	1	1	38
Reynolds (2003)	B	0_a		35	40	2	1	0	3	0	15
Reynolds et al (2004)	B	0_a		29	25	3	1	0	1	1	15
Reynolds et al (2004)	B	0_a		29	25	3	1	0	1	1	15
Reynolds, Ortengren, et al (2006)	B	0_a		35	35	4	1	0	1	1	3

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Reynolds, Ortengren, et al (2006)	B	-0.26	1.24	35	35	4	1	0	1	1	15
Reynolds, Ortengren, et al (2006)	B	0_a		35	35	4	1	0	1	1	39
Reynolds, Ortengren, et al (2006)	B	0_a		35	35	4	1	0	1	1	39
Reynolds, Richards, et al (2006)	B	0.19	2.20	11	13	4	1	0	1	1	3
Reynolds, Richards, et al (2006)	B	0.24	0.28	11	13	4	1	0	1	1	15
Reynolds, Richards, et al (2006)	B	-0.12	1.77	11	13	4	1	0	1	1	39
Reynolds, Richards, et al (2006)	B	-0.41	0.38	11	13	4	1	0	1	1	39
Stoltenberg et al (2006)	B	0.11	0.85	80	98	4	1	0	0	1	39
Taylor (2005)	B	-0.03	1.72	50	73	0	0	0	0	1	39
Tinius (2003)	B	0_a		19	22	0	1	0	1	1	39
Walderhaug (2007)	B	0_a		39	44	4	1	1	1	1	39
White et al (2007)	B	0.18	0.96	18	19	4	0	0	1	1	3
Abramowitz & Berenbaum (2007)	GI	-0.14		66	123	3	0	0	0	1	29
Adams et al (1997)	GI	0.07	1.19	420	489	1	0	0	2	1	10
Aidman & Kollaras-Mitsinikos (2006)	GI	-0.11	0.32	10	14	5	1	1	1	1	4
Aklin et al (2005)	GI	-0.10		26	25	1	1	0	1	1	4
Alexander et al (2004)	GI	0.47	0.98	82	87	2	0	1	0	1	10
Allen et al (1998)	GI	0_a		16	10	4	1	0	1	1	4
Allen et al (1998)	GI	0_a		16	10	4	1	0	1	1	10
Allen et al (1998)	GI	0_a		16	10	4	1	0	1	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Alter (2001)	GI	0.39	0.86	26	39	1	0	0	3	0	10
Aluja & Blanch (2007)	GI	0.10	0.94	742	1075	4	1	1	2	1	4
Anderson (1986)	GI	0.31		60	135	5	0	0	2	1	10
Antonowicz (2002)	GI	0.02	1.13	106	106	3	1	0	0	0	29
Archer & Webb (2006)	GI	0.14	0.99	88	219	4	1	1	0	1	29
Archer et al (1995)	GI	0.23	1.18	160	160	0	1	1	0	1	10
Baca-Garcia et al (2006)	GI	-0.11	0.97	193	124	0	1	1	1	1	29
Baca-Garcia et al (2006)	GI	-0.05	0.95	44	37	0	1	0	1	1	29
Baca-Garcia et al (2004)	GI	-0.05	0.91	124	99	0	1	1	1	1	29
Bagge et al (2004)	GI	-0.04		156	195	2	0	0	0	1	10
Baker & Yardley (2002)	GI	0.57	1.00	193	227	2	1	0	3	1	10
Balodis et al (2007)	GI	0.14	0.76	29	37	4	0	0	0	1	29
Bare (2006)	GI	-0.08		41	51	4	1	0	0	0	29
Bazargan-Hejazi et al (2007)	GI	0.34	1.30	243	169	4	0	0	1	1	4
Bembenutty & Karabenick (1998)	GI	0_a		148	221	3	1	0	0	1	10
Berlin et al (2005)	GI	-0.12	0.73	10	29	6	0	0	1	1	29
Bjork et al (2004)	GI	0.01	1.39	27	14	5	1	0	1	1	29
Brezo et al (2006)	GI	0.40		496	648	4	0	0	1	1	29
Brown et al (2006)	GI	0_a		21	37	6	0	0	1	1	29
Caci et al (2003b)	GI	0.11	1.15	197	364	4	1	1	0	1	4
Camatla et al (1995)	GI	-0.36	0.64	47	86	3	0	0	0	1	4
Case (2007)	GI	0.26	1.20	727	588	1	1	1	3	1	10
Caseras et al (2003)	GI	0.28	1.09	117	421	3	1	1	0	1	4
Caseras et al (2003)	GI	-0.16	0.99	117	421	3	1	1	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Casillas (2006)	GI	-0.18		84	125	4	1	0	1	0	10
Casillas (2006)	GI	0.14		84	125	4	1	0	1	0	10
Chabrol et al (2004)	GI	0.25		435	181	2	1	1	3	1	10
Chen et al (2007)	GI	-0.17		29	29	4	1	0	1	1	29
Chung & Martin (2002)	GI	0_a		119	54	2	0	0	1	1	4
Clark et al (2005)	GI	0.89	0.48	27	13	4	1	1	1	1	29
Clarke (2004)	GI	0.23	1.10	29	118	4	1	1	0	1	4
Clarke (2006)	GI	0.29	1.02	33	136	4	1	1	0	1	4
Clift et al (1993)	GI	-0.04	0.89	176	333	4	1	1	1	1	4
Colder & Stice (1998)	GI	-0.41		164	207	2	1	0	0	1	10
Colom et al (2007)	GI	0.07	0.67	68	67	1	1	1	3	1	10
Compton & Kaslow (2005)	GI	0.43	1.92	49	50	5	1	0	1	1	29
Cooper et al (2000)	GI	0.12		783	883	4	0	0	1	1	4
Cooper et al (2003)	GI	0.04		981	997	2	0	0	1	1	10
Corr et al (1995)	GI	0.66	1.02	15	14	0	1	1	0	1	4
Corulla (1987)	GI	0.06	1.22	92	215	4	1	1	0	1	4
Curry & Piquero (2003)	GI	-0.17	1.03	286	172	3	1	0	0	1	10
Cyders et al (2007)	GI	0	1.62	175	175	3	0	0	0	1	10
Cyders et al (2007)	GI	0.14	1.31	43	165	3	0	0	0	1	10
Cyders et al (2007)	GI	0.14	1.19	168	147	3	0	0	0	1	10
Dahlen et al (2004)	GI	-0.18	0.99	67	157	3	1	0	0	1	29
Davelaar et al (2008)	GI	0.26	1.17	22	64	0	2	0	0	1	10
Davelaar et al (2008)	GI	0.08	0.76	19	78	0	2	0	0	1	10
Davelaar et al (2008)	GI	0.36	0.56	20	68	0	2	0	0	1	10

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Davis et al (2007)	GI	0.41	0.80	81	164	5	0	0	1	1	29
De Flores et al (1986)	GI	-0.01	1.15	94	122	3	1	1	0	1	4
Deffenbacher et al (2003)	GI	0_a		137	233	3	1	0	0	1	29
DePasquale et al (2001)	GI	-0.06		41	55	2	1	0	0	1	4
Dhuse (2006)	GI	0.14		104	230	3	0	0	0	0	4
Diaz & Pickering (1993)	GI	-0.04	1.50	89	82	4	0	1	1	1	4
Dinn et al (2002)	GI	0_a		28	75	3	1	0	0	1	4
Doran, McChargue, et al (2007)	GI	0_a		87	115	3	1	0	0	1	29
Doran, Spring, et al (2007)	GI	0.39	1.94	30	30	5	1	0	2	1	29
Durante (2002)	GI	0		271	103	5	0	0	1	0	10
Enticott et al (2006)	GI	-0.20	0.83	14	17	5	1	1	1	1	29
Eysenck & Abdel-Khalik (1992)	GI	-0.11	1.02	476	486	3	0	2	0	1	4
Eysenck & Abdel-Khalik (1992)	GI	0.05	0.89	147	179	3	0	1	0	1	4
Eysenck & Jamieson (1986)	GI	0.07	0.87	523	529	1	0	0	3	1	4
Eysenck & Jamieson (1986)	GI	0.07	0.85	533	777	1	0	1	3	1	4
Eysenck (1981)	GI	0.22	1.21	118	309	1	0	1	3	1	4
Eysenck et al (1985)	GI	-0.21	1.00	559	761	6	0	1	1	1	4
Eysenck et al (1985)	GI	0.14	0.94	383	206	4	0	1	1	1	4
Eysenck et al (1990)	GI	-0.16	0.98	239	184	5	0	1	1	1	4
Eysenck et al (1990)	GI	-0.41	0.91	175	214	5	0	1	1	1	4
Fallgatter & Herrmann (2001)	GI	0.23	0.84	12	10	6	1	1	1	1	4
Fingeret et al (2005)	GI	0.02	1.28	42	49	4	0	0	1	1	29
Flora (2007)	GI	0.22		125	263	3	0	0	0	0	10
Flory et al (2006)	GI	0.36	0.99	154	197	6	0	0	1	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Ford (1995)	GI	-0.01	0.92	220	252	3	0	0	0	0	4
Fossati et al (2001)	GI	-0.07	1.01	273	490	4	0	1	0	1	29
Fossati et al (2002)	GI	0.17	1.30	209	354	2	0	1	3	1	29
Fu et al (2007)	GI	0.04	1.04	1214	1248	3	2	2	0	1	29
Galanti et al (2007)	GI	0.54		28	65	6	0	0	1	1	29
Giancola & Parrott (2005)	GI	-0.06	0.89	164	166	4	1	0	1	1	29
Glicksohn & Nahari (2007)	GI	0.24	0.93	105	127	2	1	2	0	1	4
Glicksohn & Nahari (2007)	GI	-0.06	1.00	105	127	2	1	2	0	1	29
Grano et al (2007)	GI	-0.19	0.71	520	3808	5	1	1	1	1	28
Green (1995)	GI	0.02		48	76	4	1	0	0	0	4
Gudjonsson et al (2006)	GI	0.02	1.00	683	861	3	0	1	2	1	4
Gupta & Gupta (1998)	GI	0.47	1.29	100	100	4	0	2	0	1	4
Hawton et al (2002)	GI	-0.09	1.08	2911	2374	2	1	1	3	1	10
Heaven (1989)	GI	-0.11	0.92	69	100	2	1	1	3	1	4
Heaven (1991)	GI	-0.37	1.09	70	100	2	1	1	3	1	4
Henle (2005)	GI	0.35		70	81	4	0	0	0	1	10
Hewlett & Smith (2006)	GI	0.17	1.09	120	164	4	1	1	1	1	4
Hulsey (2001)	GI	0_a		107	99	4	1	0	0	0	4
Hunt et al (2005)	GI	0.45	0.68	22	58	3	0	0	0	1	29
Jack & Ronan (1998)	GI	0_a		119	47	4	0	1	1	1	4
Jackson & Matthews (1988)	GI	0.34	1.28	30	58	5	1	1	0	1	4
January (2003)	GI	0.22		34	84	3	0	0	2	0	10
Justus et al (2001)	GI	0.25	0.96	87	103	4	0	0	0	1	4
Kazemi (2007)	GI	0.42	1.73	14	24	2	0	0	0	0	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Kazemi (2007)	GI	0.16	0.78	28	89	2	0	0	0	0	29
Keilp et al (2005)	GI	0_a		21	37	5	1	0	1	1	29
Ketzenberger & Forrest (2000)	GI	0_a		148	257	6	0	0	1	1	29
Kirby & Petry (2004)	GI	0.33	1.24	33	27	5	1	0	1	1	4
Klinteberg et al (1987)	GI	-0.22	0.62	29	32	2	0	1	3	1	4
Klinteberg et al (1987)	GI	-0.15	0.66	29	32	2	0	1	3	1	28
Krueger et al (2007)	GI	0.20	1.14	435.5	435.5	3	1	0	0	1	10
Krueger et al (2007)	GI	-0.03	0.92	435.5	435.5	3	1	0	0	1	10
Krueger et al (2007)	GI	-0.03	0.87	435.5	435.5	3	1	0	0	1	10
Lejuez et al (2002)	GI	0.43		43	43	3	1	0	1	1	4
Lejuez et al (2002)	GI	0.52		43	43	3	1	0	1	1	29
Lejuez et al (2003)	GI	-0.20		30	30	3	1	0	0	1	4
Lennings (1991)	GI	0_a		22	80	4	1	1	0	1	28
Lennings & Burns (1998)	GI	0_a		15	54	4	1	1	0	1	28
Leshem & Glicksohn (2007)	GI	0_a		59	123	2	1	2	3	1	4
Leshem & Glicksohn (2007)	GI	0_a		59	123	2	1	2	3	1	29
Li & Chen (2007)	GI	0.06	1.00	353	367	2	1	2	3	1	29
Lijffijit et al (2005)	GI	0.10	1.14	193	855	3	0	1	0	1	4
Llorenet & Torrubia (1988)	GI	0.22	1.12	121	61	3	1	1	0	1	4
Lopez Viets (2001)	GI	0.64	0.97	54	61	3	0	0	0	0	4
Luengo et al (1990)	GI	-0.01	1.13	55	252	4	1	1	0	1	4
Luengo et al (1990)	GI	-0.04	0.89	55	252	4	1	1	0	1	29
Lyke & Spinella (2004)	GI	0.39	1.25	32	80	4	0	0	1	1	29
Macpherson et al (1996)	GI	-0.04	0.77	22	19	0	0	0	0	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Macpherson et al (1996)	GI	-0.17	0.68	22	22	0	0	0	0	1	4
Magid et al (2007)	GI	0.15	0.85	111	199	3	0	0	0	1	28
Malle & Neubauer (1991)	GI	-0.61		25	40	4	1	1	0	1	10
Mallet & Vignoli (2007)	GI	-0.23	0.85	235	401	2	1	1	3	1	4
Manuck et al (1998)	GI	-0.17	0.65	59	60	6	1	0	1	1	29
McCrae & Costa (1985)	GI	-0.21	1.10	423	129	6	1	0	1	1	4
McFatter (1998)	GI	0.18	0.97	578	932	2	1	0	0	1	4
Mcleish & Oxoby (2007)	GI	-0.20	0.86	50	32	3	0	0	0	1	29
McMahon & Washburn (2003)	GI	0_a		56	100	1	0	0	3	1	10
Meadows (1995)	GI	0.24	0.70	262	336	0	1	0	0	0	10
Mehrabian (2000)	GI	0.28		107	195	3	1	0	2	1	10
Mejia et al (2006)	GI	0.33	1.10	473	644	1	1	0	3	1	10
Molto et al (1993)	GI	-0.02	0.66	347	448	3	1	1	0	1	4
Nagoshi (1999)	GI	0.04	0.93	52	71	3	1	0	0	1	4
Nagoshi et al (1994)	GI	0_a		99	91	3	1	0	0	1	4
Neal & Carey (2007)	GI	0.23	1.11	75	131	3	1	0	0	1	4
Neal & Carey (2007)	GI	0.12	0.99	75	131	3	1	0	0	1	10
Neubauer (1992)	GI	0_a		32	81	5	1	1	0	1	4
Nietfeld & Bosme (2003)	GI	-0.41		30	29	4	1	0	0	1	4
Nower et al (2004)	GI	-0.10	1.20	101	150	3	0	0	0	0	4
Nower et al (2004)	GI	0.01	1.03	462	523	3	0	0	0	0	4
Oas (1984)	GI	0.27		66	48	2	1	0	1	1	10
Overman et al (2004)	GI	0_a		240	240	3	1	0	2	1	10
Owsley (2003)	GI	-0.05	1.08	135	129	6	0	0	1	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Paaver et al (2007)	GI	0.03	0.88	222	261	2	0	1	1	1	29
Patock-Peckham & Morgan-lopez (2006)	GI	0.13	0.94	215	206	2	0	0	0	1	4
Patock-Peckham et al (1998)	GI	0_a		142	222	3	0	0	0	1	4
Patton et al (1995)	GI	0.16	1.01	130	279	2	1	0	0	1	29
Pearson et al (1986)	GI	-0.10		279	290	1	1	1	3	1	4
Peluso et al (2007)	GI	-0.21	0.53	17	34	5	1	0	1	1	29
Penas-Lledo et al (2004)	GI	0.61	1.30	49	72	1	0	1	0	1	10
Plouffe & Gravelle (1989)	GI	0_a		40	40	6	0	0	1	1	10
Pompili et al (2007)	GI	0.25	0.87	141	159	4	1	1	0	1	10
Pompili et al (2007)	GI	-0.03	0.76	141	159	4	1	1	0	1	10
Pompili et al (2007)	GI	0.18	0.82	141	159	4	1	1	0	1	29
Pontzer (2007)	GI	0.01		258	269	0	1	0	0	0	10
Ramadan & McMurran (2005)	GI	0.29	1.13	39	69	3	0	1	0	1	29
Rawlings (1984)	GI	0.06		18	17	0	1	1	0	1	4
Reynolds, Ortengren, et al (2006)	GI	0_a		35	35	4	1	0	1	1	4
Reynolds, Ortengren, et al (2006)	GI	0_a		35	35	4	1	0	1	1	29
Reynolds, Richards, et al (2006)	GI	0.37	1.35	11	13	4	1	0	1	1	29
Reynolds et al (2007)	GI	0_a		25	26	1	1	0	1	1	29
Rhyff et al (1983)	GI	0_a		135	135	3	0	0	0	1	10
Rigby et al (1989)	GI	0.33	1.00	56	59	1	1	1	3	1	4
Rigby et al (1992)	GI	0_a		48	57	1	1	1	3	1	4
Rim (1994)	GI	-0.16	1.38	53	45	4	3	2	0	1	4
Robinson (1990)	GI	-0.26		69	125	3	1	0	0	1	4
Romero et al (2001)	GI	0.08		435	529	2	0	1	3	1	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Rowe et al (1995)	GI	0.41		407	425	1	1	0	1	1	10
Sahoo (1985)	GI	0.49		80	80	2	1	2	3	1	4
Saklofske & Eysenck (1983)	GI	-0.69		20	11	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.09	1.08	84	76	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.01	0.96	69	68	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.22	0.79	61	70	1	1	0	3	1	4
Saklofske & Eysenck (1983)	GI	0.21	0.73	74	61	1	1	0	3	1	4
Sasaki & Kanachi (2005)	GI	0.32	0.90	54	40	4	1	2	0	1	10
Schaughency et al (1994)	GI	0.16	1.41	425	413	1	0	1	1	1	10
Schwartz (2007)	GI	0.27	1.21	55	168	3	1	0	0	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Schweizer (2002)	GI	0_a		26	82	4	1	1	2	1	10
Sigurdsson et al (2006)	GI	-0.02	0.91	191	242	3	1	1	0	1	4
Simons & Carey (2006)	GI	0.04	1.11	272	549	3	1	0	0	1	4
Simons (2003)	GI	0.15	1.22	97	206	3	1	0	0	1	4
Simons et al (2005)	GI	0.19	1.05	253	578	3	1	0	0	1	10
Smith et al (2006)	GI	0.02	2.64	87	98	4	1	1	0	1	29
Smith et al (2006)	GI	-0.07	0.72	44	62	4	1	1	1	1	29
Soloff et al (2003)	GI	0.24	0.90	36	21	4	1	0	1	1	29
Spence et al (1991)	GI	-0.15	0.68	183	292	3	0	0	0	1	4
Stanford et al (1995)	GI	0.12	0.88	60	154	4	1	0	0	1	29
Stanford et al (1996)	GI	0.17	1.05	278	287	2	1	0	3	1	29

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Stanford et al (1996)	GI	0.34	1.04	226	356	4	1	0	0	1	29
Starrett (1983)	GI	0.67	1.18	17	28	2	1	0	3	1	4
Starrett (1983)	GI	0.17	1.03	19	46	3	1	0	0	1	4
Starrett (1983)	GI	-0.05	0.58	26	27	1	1	0	3	1	4
Stoltenberg et al (2006)	GI	-0.38	0.81	111	87	3	1	0	0	1	10
Stoltenberg et al (2006)	GI	0.61	0.78	111	87	3	1	0	0	1	10
Stoltenberg et al (2006)	GI	0.01	0.70	111	87	3	1	0	0	1	10
Stoltenberg et al (2008)	GI	0.59	0.87	72	120	4	1	0	0	1	29
Thompson et al (2007)	GI	0	1.10	7416	7611	1	0	0	3	1	10
Torrubia et al (2001)	GI	0.03	0.96	240	491	3	1	1	0	1	4
Torrubia et al (2001)	GI	0.12	0.87	43	119	3	1	1	0	1	4
Torrubia et al (2001)	GI	-0.05	0.86	117	223	3	1	1	0	1	4
Toyer (1999)	GI	0.45	1.44	805	815	2	1	0	3	0	10
Van den Broek et al (1992)	GI	0_a		18	18	4	2	1	1	1	4
Van den Broek et al (1992)	GI	0_a		18	18	4	2	1	1	1	29
Vazsonyi et al (2006)	GI	-0.02	1.03	10041	10193	2	1	0	3	1	10
Vigil-Colet & Cordorniu-Raga (2004)	GI	0.48	1.76	16	68	4	1	1	0	1	4
Vigil-Colet (2007)	GI	-0.18	1.10	18	77	4	1	1	0	1	4
Von Knorring et al (1987)	GI	-0.04	0.88	56	81	5	1	1	1	1	28
Weller (2001)	GI	0.76		30	30	0	0	0	2	0	4
Weyers et al (1995)	GI	-0.45	1.39	40	40	4	1	1	0	1	4
Weyers et al (1995)	GI	-0.73	0.86	40	40	6	1	1	0	1	4
Wingo (2002)	GI	0.19	1.60	30	25	2	0	0	1	0	10
Zawacki (2002)	GI	-0.04		90	90	4	0	0	0	0	4

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Zimmerman et al (2004)	GI	-0.12	0.81	50	170	4	1	1	0	1	4
Zimmerman et al (2005)	GI	-0.13	0.59	26	110	4	1	1	0	1	4
Zuckerman et al (1988)	GI	-0.12	1.42	73	198	0	1	0	0	1	10
Zuckerman et al (1988)	GI	-0.13	1.00	73	198	0	1	0	0	1	10
Zuckerman et al (1988)	GI	0	0.86	73	198	0	1	0	0	1	28
Avila & Parcet (2000)	PS	0_a		23	85	3	1	1	0	1	13
Bjork et al (2004)	PS	-0.51	1.13	27	14	5	1	0	1	1	19
Caci et al (2007)	PS	-0.25	0.67	36	100	2	1	1	0	1	13
Caci et al (2007)	PS	-0.74	0.87	35	109	2	1	1	0	1	19
Caseras et al (2003)	PS	-0.11	0.97	117	421	3	1	1	0	1	13
Caseras et al (2003)	PS	-0.16	0.93	117	421	3	1	1	0	1	13
Caseras et al (2003)	PS	-0.56	1.44	117	421	3	1	1	0	1	19
Caseras et al (2003)	PS	-0.44	1.05	117	421	3	1	1	0	1	36
Davis et al (2007)	PS	0.13	1.04	81	164	5	0	0	1	1	13
Li et al (2007)	PS	0.02	1.09	235	313	3	2	2	0	1	13
Nijs et al (2007)	PS	-0.18	1.13	20	24	4	0	1	1	1	19
Pang & Schultheiss (2005)	PS	-0.45	1.56	154	172	3	0	0	0	1	19
Segarra et al (2007)	PS	-0.45	0.89	79	114	3	0	1	0	1	13
Segarra et al (2007)	PS	-0.84	0.98	79	114	3	0	1	0	1	19
Smillie et al (2006)	PS	-0.68	0.93	427	116	4	1	1	2	1	19
Stewart et al (2004)	PS	-0.37	1.15	347	550	3	0	1	0	1	36
Torrubia et al (2001)	PS	-0.24	1.12	96	276	3	1	1	0	1	13
Torrubia et al (2001)	PS	0.05	1.12	240	491	3	1	1	0	1	13
Torrubia et al (2001)	PS	-0.21	0.98	229	599	3	1	1	0	1	13

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Uzieblo et al (2007)	PS	-0.73	1.27	167	227	3	0	1	0	1	19
van den bree et al (2006)	PS	-0.55	0.92	240	340	2	0	0	1	1	36
Weyers et al (1995)	PS	-0.38	1.19	40	40	4	1	1	0	1	36
Weyers et al (1995)	PS	-0.14	1.10	40	40	6	1	1	0	1	36
Avila & Parcet (2000)	RS	0_a		23	85	3	1	1	0	1	14
Bjork et al (2004)	RS	-0.25	1.23	27	14	5	1	0	1	1	16
Bjork et al (2004)	RS	0.18	1.00	27	14	5	1	0	1	1	17
Bjork et al (2004)	RS	-0.59	0.45	27	14	5	1	0	1	1	18
Caci et al (2007)	RS	0.08	0.52	36	100	2	1	1	0	1	14
Caci et al (2007)	RS	0.09	0.92	35	109	2	1	1	0	1	16
Caci et al (2007)	RS	-0.14	1.40	35	109	2	1	1	0	1	17
Caci et al (2007)	RS	-0.42	1.26	35	109	2	1	1	0	1	18
Caseras et al (2003)	RS	0.60	1.45	117	421	3	1	1	0	1	14
Caseras et al (2003)	RS	0.53	0.86	117	421	3	1	1	0	1	14
Caseras et al (2003)	RS	0.14	0.98	117	421	3	1	1	0	1	16
Caseras et al (2003)	RS	0.13	1.06	117	421	3	1	1	0	1	17
Caseras et al (2003)	RS	-0.11	1.18	117	421	3	1	1	0	1	18
Caseras et al (2003)	RS	-0.48	0.95	117	421	3	1	1	0	1	32
Cyders et al (2007)	RS	0.03	1.19	175	175	3	0	0	0	1	16
Cyders et al (2007)	RS	0.05	1.18	175	175	3	0	0	0	1	17
Cyders et al (2007)	RS	-0.12	0.87	175	175	3	0	0	0	1	18
Davis et al (2007)	RS	0.46	1.16	81	164	5	0	0	1	1	14
Li et al (2007)	RS	0.31	1.11	235	313	3	2	2	0	1	14
Nijs et al (2007)	RS	-0.68	0.57	20	24	4	0	1	1	1	16

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Nijs et al (2007)	RS	-0.37	0.85	20	24	4	0	1	1	1	17
Nijs et al (2007)	RS	-0.49	1.13	20	24	4	0	1	1	1	18
Nijs et al (2007)	RS	-0.70	0.72	20	24	4	0	1	1	1	31
Pang & Schultheiss (2005)	RS	0.15	1.38	154	172	3	0	0	0	1	16
Pang & Schultheiss (2005)	RS	0.15	0.98	154	172	3	0	0	0	1	17
Pang & Schultheiss (2005)	RS	0.01	1.06	154	172	3	0	0	0	1	18
Pang & Schultheiss (2005)	RS	0.15	1.12	154	172	3	0	0	0	1	31
Segarra et al (2007)	RS	0.49	1.14	79	114	3	0	1	0	1	14
Segarra et al (2007)	RS	0.01	1.47	79	114	3	0	1	0	1	16
Segarra et al (2007)	RS	-0.11	1.08	79	114	3	0	1	0	1	17
Segarra et al (2007)	RS	-0.34	0.97	79	114	3	0	1	0	1	18
Segarra et al (2007)	RS	-0.20	0.98	79	114	3	0	1	0	1	31
Smillie et al (2006)	RS	0.14	1.18	427	116	4	1	1	2	1	16
Smillie et al (2006)	RS	0.25	0.80	427	116	4	1	1	2	1	17
Smillie et al (2006)	RS	-0.54	1.11	427	116	4	1	1	2	1	18
Torrubia et al (2001)	RS	0.53	1.45	229	599	3	1	1	0	1	14
Torrubia et al (2001)	RS	0.45	1.12	51	156	3	1	1	0	1	14
Torrubia et al (2001)	RS	0.45	1.03	240	491	3	1	1	0	1	14
Uzieblo et al (2007)	RS	-0.02	1.07	167	227	3	0	1	0	1	16
Uzieblo et al (2007)	RS	0.04	1.52	167	227	3	0	1	0	1	17
Uzieblo et al (2007)	RS	-0.31	0.81	167	227	3	0	1	0	1	18
Uzieblo et al (2007)	RS	-0.13	1.13	167	227	3	0	1	0	1	31
van den bree et al (2006)	RS	-0.61	1.40	240	340	2	0	0	1	1	32
Weyers et al (1995)	RS	-0.75	1.10	40	40	4	1	1	0	1	32

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Weyers et al (1995)	RS	-0.38	0.94	40	40	6	1	1	0	1	32
Aklin et al (2005)	SS/RT	0.14		26	25	1	1	0	1	1	12
Alexander et al (2004)	SS/RT	0.29	1.00	82	87	2	0	1	0	1	11
Alter (2001)	SS/RT	-0.74	0.67	26	39	1	0	0	3	0	33
Aluja & Blanch (2007)	SS/RT	0.52	1.14	742	1075	4	1	1	2	1	5
Anestis et al (2007)	SS/RT	0	0.83	12	58	3	1	0	0	1	9
Bates & Labouvie (1995)	SS/RT	0.56		654	654	2	0	0	2	1	21
Bazargan-Hejazi et al (2007)	SS/RT	-0.45	1.03	243	169	4	0	0	1	1	11
Bazargan-Hejazi et al (2007)	SS/RT	0.38	1.09	243	169	4	0	0	1	1	30
Billieux et al (2008)	SS/RT	0.46	0.88	74	76	4	1	1	2	1	9
Bjork et al (2004)	SS/RT	0.60	1.43	27	14	5	1	0	1	1	20
Bjork et al (2004)	SS/RT	0.48	1.73	27	14	5	1	0	1	1	21
Bjork et al (2004)	SS/RT	0.14	1.39	27	14	5	1	0	1	1	22
Bjork et al (2004)	SS/RT	0.34	1.12	27	14	5	1	0	1	1	23
Bjork et al (2004)	SS/RT	0.49	1.57	27	14	5	1	0	1	1	30
Caci et al (2003b)	SS/RT	0.57	1.20	197	364	4	1	1	0	1	5
Caci et al (2003a)	SS/RT	0.19	0.88	201	390	4	1	1	0	1	24
Camatla et al (1995)	SS/RT	0.64	0.67	47	86	3	0	0	0	1	5
Caseras et al (2003)	SS/RT	0.04	1.00	117	421	3	1	1	0	1	12
Casillas (2006)	SS/RT	0.61		84	125	4	1	0	1	0	9
Casillas (2006)	SS/RT	0.32		84	125	4	1	0	1	0	20
Casillas (2006)	SS/RT	0.72		84	125	4	1	0	1	0	21
Casillas (2006)	SS/RT	0.49		84	125	4	1	0	1	0	23
Cherpitel (1993)	SS/RT	-0.54		575	575	0	0	0	4	1	11

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Cherpitel (1993)	SS/RT	0.30		575	575	0	0	0	4	1	11
Cherpitel (1993)	SS/RT	0.30		575	575	0	0	0	4	1	12
Claes et al (2000)	SS/RT	0.43		159	156	6	1	1	1	1	24
Clarke (2004)	SS/RT	-0.31	1.18	29	118	4	1	1	0	1	5
Clift et al (1993)	SS/RT	0.51	0.81	176	333	4	1	1	1	1	5
Colom et al (2007)	SS/RT	0.92	1.75	68	67	1	1	1	3	1	12
Cooper et al (2003)	SS/RT	0.45		981	997	2	0	0	1	1	23
Copping (2007)	SS/RT	1.16		94	104	1	1	1	3	0	9
Corulla (1987)	SS/RT	0.54	0.90	92	215	4	1	1	0	1	5
Cross (2007)	SS/RT	0.49	1.04	127	201	4	0	1	2	0	30
Cross (2007)	SS/RT	0.22	1.30	127	201	4	0	1	2	0	11
Cross (2008)	SS/RT	0.25	1.17	50	65	5	0	1	1	0	11
Cross (2009)	SS/RT	0.34	1.03	2261	1514	5	0	1	1	0	11
Curran (2006)	SS/RT	-0.43	0.38	61	19	5	1	0	1	0	20
Curran (2006)	SS/RT	-0.27	0.47	61	19	5	1	0	1	0	21
Curran (2006)	SS/RT	-0.60	0.53	61	19	5	1	0	1	0	22
Curran (2006)	SS/RT	-0.35	0.69	61	19	5	1	0	1	0	23
Curran (2006)	SS/RT	-0.54	0.44	61	19	5	1	0	1	0	34
Curry (2005)	SS/RT	0.54		117	173	2	0	0	1	0	9
Cyders et al (2007)	SS/RT	-0.02	1.07	175	175	3	0	0	0	1	9
Cyders et al (2007)	SS/RT	0.52	0.72	43	165	3	0	0	0	1	9
Cyders et al (2007)	SS/RT	0.51	0.64	168	147	3	0	0	0	1	9
d'Acrement & Van Der Linden (2005)	SS/RT	0.70	0.80	314	314	2	1	1	3	1	9
Dahlen et al (2005)	SS/RT	0.54	0.97	67	157	3	1	0	0	1	12

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Dahlen et al (2005)	SS/RT	0.14	0.96	67	157	3	1	0	0	1	12
DePasquale et al (2001)	SS/RT	0.70		41	55	2	1	0	0	1	5
Dhuse (2006)	SS/RT	0.70		104	230	3	0	0	0	0	5
Diaz & Pickering (1993)	SS/RT	0.22	0.94	89	82	4	0	1	1	1	5
Driscoll et al (2006)	SS/RT	-0.77	1.24	221	386	2	0	1	3	1	33
Eysenck & Abdel-Khalik (1992)	SS/RT	0.54	0.97	476	486	3	0	2	0	1	5
Eysenck & Abdel-Khalik (1992)	SS/RT	0.55	0.66	147	179	3	0	1	0	1	5
Eysenck & Jamieson (1986)	SS/RT	0.55	0.81	533	777	1	0	1	3	1	5
Eysenck & Jamieson (1986)	SS/RT	0.37	0.70	523	529	1	0	0	3	1	5
Eysenck (1981)	SS/RT	0.19	0.92	118	309	1	0	1	3	1	5
Eysenck et al (1985)	SS/RT	0.27	1.13	559	761	6	0	1	1	1	5
Eysenck et al (1985)	SS/RT	0.65	0.75	383	206	4	0	1	1	1	5
Eysenck et al (1990)	SS/RT	0.75	1.03	175	214	5	0	1	1	1	5
Eysenck et al (1990)	SS/RT	0.92	0.97	239	184	5	0	1	1	1	5
Fallgatter & Herrmann (2001)	SS/RT	0.28	0.72	12	10	6	1	1	1	1	5
Fischer & Smith (2004)	SS/RT	0.44		113	247	0	0	0	0	**1**	11
Fischer & Smith (2004)	SS/RT	0.45		113	247	0	0	0	0	1	11
Flannery et al (1994)	SS/RT	0.29	1.27	370	369	1	1	0	3	1	12
Flannery et al (1994)	SS/RT	-0.20	1.08	144	131	1	1	0	3	1	12
Flora (2007)	SS/RT	-0.12		125	263	3	0	0	0	0	12
Flora (2007)	SS/RT	-0.08		125	263	3	0	0	0	0	20
Flory et al (2006)	SS/RT	0.13	0.77	154	197	6	0	0	1	1	12
Flory et al (2006)	SS/RT	0.40	0.99	154	197	6	0	0	1	1	20
Flory et al (2006)	SS/RT	0.76	1.53	154	197	6	0	0	1	1	21

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Flory et al (2006)	SS/RT	0.19	1.02	154	197	6	0	0	1	1	22
Flory et al (2006)	SS/RT	0.44	0.77	154	197	6	0	0	1	1	23
Flory et al (2006)	SS/RT	0.54	1.06	154	197	6	0	0	1	1	30
Ford (1995)	SS/RT	0	0.87	220	252	3	0	0	0	0	20
Ford (1995)	SS/RT	0.44	0.73	220	252	3	0	0	0	0	30
Franken et al (2005)	SS/RT	0	1.47	14	21	4	1	1	2	1	24
Garland (1999)	SS/RT	-0.05		26	35	5	1	0	1	0	30
Garland (1999)	SS/RT	-0.03	1.16	26	35	5	1	0	1	0	34
Giancola & Parrott (2005)	SS/RT	0.70	0.69	164	166	4	1	0	1	1	30
Glicksohn & Nahari (2007)	SS/RT	0.68	0.92	105	127	2	1	2	0	1	5
Green (1995)	SS/RT	0.04		48	76	4	1	0	0	0	5
Gudjonsson et al (2006)	SS/RT	0.48	0.80	699	875	3	0	1	2	1	5
Hartman & Rawson (1992)	SS/RT	0.31	1.89	26	77	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.79	1.73	29	27	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.66	1.62	26	77	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.80	0.85	29	27	3	1	0	0	1	21
Hartman & Rawson (1992)	SS/RT	0.83	1.69	26	77	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.34	1.16	29	27	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.60	0.82	26	77	3	1	0	0	1	23
Hartman & Rawson (1992)	SS/RT	0.05	0.59	29	27	3	1	0	0	1	23
Heaven (1991)	SS/RT	0.23	1.09	70	100	2	1	1	3	1	11
Heaven (1991)	SS/RT	0.13	0.69	70	100	2	1	1	3	1	12
Heaven (1991)	SS/RT	0.51	1.05	70	100	2	1	1	3	1	5
Hutchinson et al (1998)	SS/RT	-0.09	0.79	87	116	3	1	0	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Jack & Ronan (1998)	SS/RT	0.56	0.94	119	47	4	0	1	1	1	30
Justus et al (2001)	SS/RT	0.75	0.88	87	103	4	0	0	0	1	5
Justus et al (2001)	SS/RT	0.37	1.23	87	103	4	0	0	0	1	20
Justus et al (2001)	SS/RT	0.41	0.79	87	103	4	0	0	0	1	21
Justus et al (2001)	SS/RT	0.41	0.90	87	103	4	0	0	0	1	23
Justus et al (2001)	SS/RT	-0.82	0.90	87	103	4	0	0	0	1	33
Kirby & Petry (2004)	SS/RT	0.85	0.97	33	27	5	1	0	1	1	5
Klinteberg et al (1987)	SS/RT	0.06	0.85	29	32	2	0	1	3	1	37
Krueger et al (2007)	SS/RT	0.56	1.26	435.5	435.5	0	1	0	0	1	12
Krueger et al (2007)	SS/RT	0.19	1.03	435.5	435.5	0	1	0	0	1	12
Lejuez et al (2002)	SS/RT	0.70		43	43	3	1	0	1	1	5
Lejuez et al (2002)	SS/RT	0.90		43	43	3	1	0	1	1	30
Lejuez et al (2003)	SS/RT	0.26		30	30	3	1	0	0	1	30
Lennings (1991)	SS/RT	0_a		22	80	4	1	1	0	1	12
Lennings (1991)	SS/RT	0_a		22	80	4	1	1	0	1	30
Leshem & Glicksohn (2007)	SS/RT	0_a		59	123	2	1	2	3	1	5
Lijffijit et al (2005)	SS/RT	0.62	0.98	193	855	3	0	1	0	1	5
Lonczak et al (2007)	SS/RT	0.54	1.56	780	432	5	0	0	1	1	12
Luengo et al (1990)	SS/RT	0.57	0.85	55	252	4	1	1	0	1	5
Lundahl (1995)	SS/RT	1.12	0.66	21	23	3	0	0	0	0	5
Lundahl (1995)	SS/RT	0.66	1.94	21	23	3	0	0	0	0	20
Lundahl (1995)	SS/RT	0_a		21	23	3	0	0	0	0	21
Lundahl (1995)	SS/RT	0_a		21	23	3	0	0	0	0	22
Lundahl (1995)	SS/RT	1.20	0.35	21	23	3	0	0	0	0	23

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Magid & Colder (2007)	SS/RT	0.51	0.91	131	136	3	0	0	0	1	9
Magid et al (2007)	SS/RT	0.18	0.73	111	199	3	0	0	0	1	37
Mallet & Vignoli (2007)	SS/RT	-0.30	1.07	235	401	2	1	1	3	1	12
Mallet & Vignoli (2007)	SS/RT	0.79	1.00	235	401	2	1	1	3	1	12
Matczak (1990)	SS/RT	0.39		152.5	152.5	2	0	1	3	1	30
McAlister et al (2005)	SS/RT	-0.39		43	76	3	0	1	0	1	24
McDaniel & Zuckerman (2003)	SS/RT	0.32	1.18	347	436	6	1	0	1	1	34
Meadows (1995)	SS/RT	0.54	0.98	262	336	0	1	0	0	0	30
Nagoshi (1999)	SS/RT	0.65	0.91	52	71	3	1	0	0	1	5
Ng et al (1998)	SS/RT	0.45	0.76	101	101	1	2	2	3	1	12
Overman et al (2004)	SS/RT	0_a		240	240	3	1	0	2	1	12
Owsley (2003)	SS/RT	0.52	1.46	135	129	6	0	0	1	1	5
Pearson et al (1986)	SS/RT	0.54		279	290	1	1	1	3	1	5
Pearson et al (1986)	SS/RT	0.49		279	290	1	1	1	3	1	12
Perez & Torrubia (1985)	SS/RT	0.61	1.47	173	176	3	1	1	0	1	30
Perez & Torrubia (1985)	SS/RT	0.30	1.31	173	176	3	1	1	0	1	20
Perez & Torrubia (1985)	SS/RT	0.94	1.62	173	176	3	1	1	0	1	21
Perez & Torrubia (1985)	SS/RT	-0.20	1.14	173	176	3	1	1	0	1	22
Perez & Torrubia (1985)	SS/RT	0.26	1.14	173	176	3	1	1	0	1	23
Pfefferbaum et al (1994)	SS/RT	0.54		148	148	3	0	0	0	1	23
Plastow (2007)	SS/RT	0.73	1.01	56	267	3	0	0	0	0	9
Ramadan & McMurran (2005)	SS/RT	0.80	0.50	39	69	3	0	1	0	1	30
Rammsayer et al (2000)	SS/RT	-0.14	0.75	25	35	4	1	1	0	1	24
Rawlings (1984)	SS/RT	-0.08		18	17	0	1	1	0	1	5

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Reeve (2007)	SS/RT	0.68	1.35	72	125	3	1	0	0	1	24
Reynolds, Ortengren, et al (2006)	SS/RT	0_a		35	35	4	1	0	1	1	5
Rim (1994)	SS/RT	-0.24	0.65	53	45	4	2	2	0	1	5
Romero et al (2001)	SS/RT	0.31		435	529	2	0	1	3	1	20
Romero et al (2001)	SS/RT	0.35		435	529	2	0	1	3	1	21
Romero et al (2001)	SS/RT	0.03		435	529	2	0	1	3	1	22
Romero et al (2001)	SS/RT	0.16		435	529	2	0	1	3	1	23
Roth et al (2007)	SS/RT	0.21	1.09	1095	1244	6	1	1	1	1	12
Roth et al (2007)	SS/RT	0.16	1.00	1095	1244	6	1	1	1	1	12
Roth et al (2007)	SS/RT	0.17	0.93	1095	1244	6	1	1	1	1	12
Sahoo (1985)	SS/RT	0_a		80	80	0	1	2	3	1	11
Saklofske & Eysenck (1983)	SS/RT	0.11	2.05	20	11	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.29	0.80	84	76	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.80	0.78	74	61	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.66	0.72	69	68	1	1	0	3	1	5
Saklofske & Eysenck (1983)	SS/RT	0.56	0.65	61	70	1	1	0	3	1	5
Sasaki & Kanachi (2005)	SS/RT	0.42	1.17	54	40	4	1	2	0	1	30
Sigurdsson et al (2006)	SS/RT	0.50	0.79	191	242	3	1	1	0	1	5
Simo et al (1991)	SS/RT	-0.05	1.10	136	144	3	1	1	2	1	20
Simo et al (1991)	SS/RT	0.49	1.84	136	144	3	1	1	2	1	21
Simo et al (1991)	SS/RT	0.29	1.28	136	144	3	1	1	2	1	22
Simo et al (1991)	SS/RT	0.94	1.09	136	144	3	1	1	2	1	23
Simo et al (1991)	SS/RT	0.71	1.00	136	144	3	1	1	2	1	30
Spillane & Smith (2006a)	SS/RT	0.35	2.54	97	117	2	0	0	0	1	9

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Spillane & Smith (2006b)	SS/RT	0.25	0.98	148	210	3	0	0	0	1	9
Spinella (2005)	SS/RT	0.76	1.05	50	51	4	1	0	1	1	12
Stewart et al (2004)	SS/RT	0.09	1.11	347	550	3	0	1	0	1	12
Torrubia et al (2001)	SS/RT	0.31	1.11	229	599	3	1	1	0	1	20
Torrubia et al (2001)	SS/RT	0.72	1.26	229	599	3	1	1	0	1	21
Torrubia et al (2001)	SS/RT	0.01	1.26	229	599	3	1	1	0	1	22
Torrubia et al (2001)	SS/RT	0.13	0.97	229	599	3	1	1	0	1	23
Torrubia et al (2001)	SS/RT	0.45	1.09	229	599	3	1	1	0	1	30
van den bree et al (2006)	SS/RT	0.10	1.00	240	340	2	0	0	1	1	12
Van der Linden et al (2006)	SS/RT	0.41	0.87	39	195	4	1	1	0	1	9
Verdejo-Garcia et al (2007)	SS/RT	0_a		14	22	5	1	1	1	1	9
Vigil - Colet & Cordorniu-Raga (2004)	SS/RT	0.47	0.85	16	68	4	1	1	0	1	5
Vigil - Colet & Cordorniu-Raga (2004)	SS/RT	0.47	1.33	16	68	4	1	1	0	1	24
Vigil-Colet & Morales-Vives (2005)	SS/RT	0.26	0.91	107	134	1	1	1	3	1	24
Vigil-Colet (2007)	SS/RT	0.23	1.33	18	77	4	1	1	0	1	5
Vigil-Colet (2007)	SS/RT	0.55	0.95	18	77	4	1	1	0	1	24
Vigil-Colet et al (in press)	SS/RT	0.14	1.02	208	114	5	1	1	1	1	24
Vigil-Colet et al (in press)	SS/RT	0.23	0.92	72	150	4	1	1	0	1	24
Von Knorrin et al (1987)	SS/RT	0.10	0.92	56	81	5	1	1	1	1	37
Weyers et al (1995)	SS/RT	0.54	1.64	40	40	6	1	1	0	1	5
Weyers et al (1995)	SS/RT	0.88	0.92	40	40	4	1	1	0	1	5
Weyers et al (1995)	SS/RT	-0.53	2.15	40	40	4	1	1	0	1	12
Weyers et al (1995)	SS/RT	-0.32	1.15	40	40	6	1	1	0	1	12
Weyers et al (1995)	SS/RT	0.11	1.02	40	40	4	1	1	0	1	30

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Weyers et al (1995)	SS/RT	0.26	0.76	40	40	6	1	1	0	1	30
Wilson & Daly (2006)	SS/RT	0.54	0.85	165	119	2	0	0	3	1	30
Yang (2002)	SS/RT	1.10		189	216	4	1	0	0	0	34
Yang (2002)	SS/RT	0.36	0.91	189	216	4	1	0	0	0	34
Zaleskiewicz (2001)	SS/RT	0.49		65	94	4	1	1	0	1	11
Zaleskiewicz (2001)	SS/RT	0.51		65	94	4	1	1	0	1	11
Zimmerman et al (2004)	SS/RT	0.64	0.85	50	170	4	1	1	0	1	5
Zimmerman et al (2005)	SS/RT	0.84	0.88	26	110	4	1	1	0	1	5
Zuckerman et al (1978)	SS/RT	0.10	1.11	97	122	3	1	0	1	1	20
Zuckerman et al (1978)	SS/RT	0.45	0.93	97	122	3	1	0	1	1	21
Zuckerman et al (1978)	SS/RT	-0.10	0.91	97	122	3	1	0	1	1	22
Zuckerman et al (1978)	SS/RT	0.36	0.78	97	122	3	1	0	1	1	23
Zuckerman et al (1978)	SS/RT	0.32	0.75	97	122	3	1	0	1	1	30
Zuckerman et al (1988)	SS/RT	0.65	1.09	73	198	0	1	0	0	1	11
Zuckerman et al (1988)	SS/RT	0.25	0.95	73	198	0	1	0	0	1	12
Zuckerman et al (1988)	SS/RT	0.25	1.10	73	198	0	1	0	0	1	20
Zuckerman et al (1988)	SS/RT	0.29	1.28	73	198	0	1	0	0	1	21
Zuckerman et al (1988)	SS/RT	-0.04	1.09	73	198	0	1	0	0	1	22
Zuckerman et al (1988)	SS/RT	0.54	0.66	73	198	0	1	0	0	1	23
Zuckerman et al (1988)	SS/RT	0.15	0.93	73	198	0	1	0	0	1	37
Anestis et al (2007)	SF	-0.40	1.26	12	58	3	1	0	0	1	6
Anestis et al (2007)	SF	-0.68	1.95	12	58	3	1	0	0	1	7
Anestis et al (2007)	SF	-0.27	0.88	12	58	3	1	0	0	1	8
Baca-Garcia et al (2006)	SF	-0.10	0.86	44	37	0	1	0	1	1	0

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Baca-Garcia et al (2006)	SF	-0.32	0.77	193	124	0	1	1	1	1	0
Baca-Garcia et al (2006)	SF	0.01	0.99	44	37	0	1	0	1	1	1
Baca-Garcia et al (2006)	SF	0.02	0.94	193	124	0	1	1	1	1	1
Baca-Garcia et al (2006)	SF	0.01	1.43	193	124	0	1	1	1	1	2
Baca-Garcia et al (2006)	SF	-0.03	0.97	44	37	0	1	0	1	1	2
Baca-Garcia et al (2004)	SF	0	0.87	124	99	0	1	1	1	1	0
Baca-Garcia et al (2004)	SF	0.03	0.99	124	99	0	1	1	1	1	1
Baca-Garcia et al (2004)	SF	-0.13	0.87	124	99	0	1	1	1	1	2
Balodis et al (2007)	SF	0.06	1.00	29	37	4	0	0	0	1	0
Balodis et al (2007)	SF	0.22	0.72	29	37	4	0	0	0	1	1
Balodis et al (2007)	SF	-0.10	0.91	29	37	4	0	0	0	1	2
Berlin et al (2005)	SF	-0.17	0.96	10	29	6	0	0	1	1	0
Berlin et al (2005)	SF	0.06	1.09	10	29	6	0	0	1	1	1
Berlin et al (2005)	SF	-0.17	0.47	10	29	6	0	0	1	1	2
Billieux et al (2008)	SF	0.41	0.90	74	76	4	1	1	2	1	6
Billieux et al (2008)	SF	0.09	0.90	74	76	4	1	1	2	1	7
Billieux et al (2008)	SF	-0.23	0.67	74	76	4	1	1	2	1	8
Bjork et al (2004)	SF	-0.05	1.03	27	14	5	1	0	1	1	0
Bjork et al (2004)	SF	-0.07	1.38	27	14	5	1	0	1	1	1
Bjork et al (2004)	SF	0.13	0.09	27	14	5	1	0	1	1	2
Caci et al (2003b)	SF	0.36	0.99	194	342	4	1	1	0	1	0
Caci et al (2003b)	SF	0.18	1.19	194	342	4	1	1	0	1	1
Caci et al (2003b)	SF	0.02	1.05	194	342	4	1	1	0	1	2
Caci et al (2003a)	SF	0.08	0.91	201	390	4	1	1	0	1	25

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Calvete & Cardenoso (2005)	SF	0.36	0.90	365	491	2	0	1	3	1	35
Casillas (2006)	SF	0.39		84	125	4	1	0	1	1	2
Casillas (2006)	SF	0.30		84	125	4	1	0	1	0	6
Casillas (2006)	SF	0		84	125	4	1	0	1	0	7
Casillas (2006)	SF	-0.10		84	125	4	1	0	1	0	8
Claes et al (2000)	SF	0.33		159	156	6	1	1	1	1	25
Clark et al (2005)	SF	0.75	0.90	27	13	4	1	1	1	1	0
Clark et al (2005)	SF	0.65	0.66	27	13	4	1	1	1	1	1
Clark et al (2005)	SF	0.61	0.55	27	13	4	1	1	1	1	2
Copping (2007)	SF	-0.20	0.68	94	104	1	1	1	3	0	6
Copping (2007)	SF	0	0.90	94	104	1	1	1	3	0	7
Copping (2007)	SF	-0.21	0.60	94	104	1	1	1	3	0	8
Cyders et al (2007)	SF	0.43	1.05	43	165	3	0	0	0	1	6
Cyders et al (2007)	SF	0	1.00	175	175	3	0	0	0	1	6
Cyders et al (2007)	SF	-0.14	0.76	168	147	3	0	0	0	1	6
Cyders et al (2007)	SF	-0.09	1.09	43	165	3	0	0	0	1	7
Cyders et al (2007)	SF	-0.09	1.00	175	175	3	0	0	0	1	7
Cyders et al (2007)	SF	-0.07	0.83	168	147	3	0	0	0	1	7
Cyders et al (2007)	SF	0.05	1.23	175	175	3	0	0	0	1	8
Cyders et al (2007)	SF	0	1.11	168	147	3	0	0	0	1	8
Cyders et al (2007)	SF	0.15	1.00	43	165	3	0	0	0	1	8
d'Acrement & Van Der Linden (2005)	SF	0	0.99	314	314	2	1	1	3	1	6
d'Acrement & Van Der Linden (2005)	SF	0.08	0.92	314	314	2	1	1	3	1	7
d'Acrement & Van Der Linden (2005)	SF	-0.28	0.82	314	314	2	1	1	3	1	8

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Davis et al (2002)	SF	0.11	0.93	104	107	4	1	0	0	1	26
de Wit et al (2007)	SF	0.06	1.08	303	303	6	0	0	1	1	0
de Wit et al (2007)	SF	-0.14	1.24	303	303	6	0	0	1	1	1
de Wit et al (2007)	SF	0.29	1.03	303	303	6	0	0	1	1	2
Dhuse (2006)	SF	-0.09		104	230	3	0	0	0	0	0
Dhuse (2006)	SF	0.06		104	230	3	0	0	0	0	1
Dhuse (2006)	SF	0.38		104	230	3	0	0	0	0	2
Driscoll et al (2006)	SF	-0.37	1.02	221	386	2	0	1	3	1	26
D'zurilla et al (1998)	SF	0.32	1.03	405	499	3	1	0	2	1	35
D'zurilla et al (1998)	SF	0.10	0.98	30	70	6	1	0	2	1	35
D'zurilla et al (1998)	SF	0.06	0.88	30	70	6	1	0	2	1	35
Enticott et al (2006)	SF	-0.38	0.45	14	17	5	1	1	1	1	0
Enticott et al (2006)	SF	-0.14	1.52	14	17	5	1	1	1	1	1
Enticott et al (2006)	SF	-0.02	1.23	14	17	5	1	1	1	1	2
Flory et al (2006)	SF	0.23	1.17	154	197	6	0	0	1	1	0
Flory et al (2006)	SF	0.13	1.03	154	197	6	0	0	1	1	1
Flory et al (2006)	SF	0.44	1.08	154	197	6	0	0	1	1	2
Fossati et al (2004)	SF	-0.08	0.94	265	482	4	0	1	0	1	0
Fossati et al (2004)	SF	-0.08	1.15	265	482	4	0	1	0	1	1
Fossati et al (2004)	SF	-0.04	1.08	265	482	4	0	1	0	1	2
Fox et al (2007)	SF	0_a		26	24	0	0	0	1	1	26
Franken et al (2005)	SF	-0.29	0.49	14	21	4	1	1	2	1	25
Fu et al (2007)	SF	0.02	1.00	1214	1248	3	2	2	0	1	1
Fu et al (2007)	SF	0.07	1.10	1214	1248	3	2	2	0	1	2

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Galanti et al (2007)	SF	0.69		28	65	6	0	0	1	1	0
Galanti et al (2007)	SF	0.60		28	65	6	0	0	1	1	1
Justus et al (2001)	SF	-0.23	0.88	87	103	4	0	0	0	1	26
Kirkcaldy et al (1998)	SF	-0.81	0.72	55	56	1	1	1	3	1	26
Lehnart et al (1994)	SF	0.38	0.53	215	108	2	0	0	3	1	26
Lyke & Spinella (2004)	SF	0.29	0.82	32	80	4	0	0	1	1	0
Lyke & Spinella (2004)	SF	0.38	1.45	32	80	4	0	0	1	1	1
Lyke & Spinella (2004)	SF	0.05	2.13	32	80	4	0	0	1	1	2
Magid & Colder (2007)	SF	-0.24	1.21	131	136	3	0	0	0	1	6
Magid & Colder (2007)	SF	-0.04	1.12	131	136	3	0	0	0	1	7
Magid & Colder (2007)	SF	0.07	1.19	131	136	3	0	0	0	1	8
Maydeu-Olivares et al (2000)	SF	0_a		121	651	3	1	1	0	1	35
McAlister et al (2005)	SF	0.12		43	76	3	0	1	0	1	25
Pfefferbaum et al (1994)	SF	0.30		148	148	3	0	0	0	1	26
Plastow (2007)	SF	-0.05	0.98	56	267	3	0	0	0	0	6
Plastow (2007)	SF	-0.02	1.44	56	267	3	0	0	0	0	7
Plastow (2007)	SF	-0.04	0.89	56	267	3	0	0	0	0	8
Pompili et al (2007)	SF	0.22	0.99	141	159	4	1	1	0	1	2
Ramadan & McMurran (2005)	SF	0.36	1.61	39	69	3	0	1	0	1	35
Rammsayer et al (2000)	SF	-0.23	0.66	25	35	4	1	1	0	1	25
Reeve (2007)	SF	0.05	0.78	72	125	3	1	0	0	1	25
Reto et al (1993)	SF	0.05	0.59	57	126	5	0	0	0	1	26
Rose (2007)	SF	0.32	0.87	89	148	3	1	0	0	1	26
Simons et al (2004)	SF	0.50	1.02	228	363	3	1	0	0	1	26

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Spillane & Smith (2006a)	SF	-0.11	1.35	97	117	2	0	0	0	1	6
Spillane & Smith (2006a)	SF	0.05	1.99	97	117	2	0	0	0	1	7
Spillane & Smith (2006a)	SF	-0.40	1.73	97	117	2	0	0	0	1	8
Spillane & Smith (2006b)	SF	0.15	0.62	148	210	3	0	0	0	1	6
Spillane & Smith (2006b)	SF	0.04	1.00	148	210	3	0	0	0	1	7
Spillane & Smith (2006b)	SF	0	0.93	148	210	3	0	0	0	1	8
Spinella (2005)	SF	0.45	0.81	49	49	4	1	0	1	1	0
Spinella (2005)	SF	-0.07	0.83	49	49	4	1	0	1	1	1
Spinella (2005)	SF	0.37	0.50	49	49	4	1	0	1	1	2
Stoltenberg et al (2008)	SF	0.50	1.55	72	120	4	1	0	0	1	0
Stoltenberg et al (2008)	SF	0.53	0.95	72	120	4	1	0	0	1	1
Stoltenberg et al (2008)	SF	0.39	1.11	72	120	4	1	0	0	1	2
Sullivan (1997)	SF	0.35	1.53	172	172	4	0	0	1	0	25
Van der Linden et al (2006)	SF	0.45	0.67	39	195	4	1	1	0	1	6
Van der Linden et al (2006)	SF	-0.10	0.49	39	195	4	1	1	0	1	7
Van der Linden et al (2006)	SF	-0.11	0.72	39	195	4	1	1	0	1	8
Verdejo-Garcia et al (2007)	SF	0_a		14	22	5	1	1	1	1	6
Verdejo-Garcia et al (2007)	SF	0_a		14	22	5	1	1	1	1	7
Verdejo-Garcia et al (2007)	SF	0_a		14	22	5	1	1	1	1	8
Vigil - Colet & Cordorniu-Raga (2004)	SF	0.40	1.67	16	68	4	1	1	0	1	25
Vigil-Colet & Morales-Vives (2005)	SF	0.23	0.92	107	134	1	1	1	3	1	0
Vigil-Colet & Morales-Vives (2005)	SF	0.02	0.96	107	134	1	1	1	3	1	1
Vigil-Colet & Morales-Vives (2005)	SF	0	0.95	107	134	1	1	1	3	1	2
Vigil-Colet & Morales-Vives (2005)	SF	0.03	0.98	107	134	1	1	1	3	1	25

Study	Domain	d	VR	NM	NF	Age	Author Sex	Nationality	Population	Published	Category
Vigil-Colet (2007)	SF	-0.30	0.88	18	77	4	1	1	0	1	25
Vigil-Colet et al (2008)	SF	0.02	1.03	208	114	5	1	1	1	1	25
Vigil-Colet et al (2008)	SF	0.21	0.75	72	150	4	1	1	0	1	25
Zuckerman et al (1988)	SF	0	1.42	73	198	0	1	0	0	1	26

Note: Domain: B = Behavioural Measures, GI = General Measures of Impulsivity, PS = Punishment Sensitivity, RS = Reward Sensitivity, SS/RT = Sensation Seeking and Risk Taking, SF = Specific Forms of Impulsivity; *d* = effect size; subscript *a* = effect size estimated as zero due to insufficient information; VR = Untransformed Variance Ratio; NM = *n* males; NF = *n* females; Age: 0 = Unspecified/ Wide age range, 1 = 10-15 years old, 2 = 15-18 years old, 3 = 18-21 years old, 4 = 21-30 years old, 5 = 30-40 years old, 6 = 40+ years old; Author Sex: 0 = Female, 1 = Male, 2 = Information not found; Nationality: 0 = US, Canada & Central America, 1 = UK, Europe, Australia/New Zealand, 2 = Asia, Africa & Middle East; Population: 0 = University Students (Including Undergraduates, College Students, and Post-Graduate Students), 1 = Community, 2 = Mixed, 3 = Schools (up to age 18), 4 = Not Specified; Published: 0 = Unpublished Study, 1 = Published Study; Category: 0 = BIS Cognitive Subscale (Barrett Impulsivity Scale), 1 = BIS Motor (Barrett Impulsivity Subscale), 2 = BIS Non Planning (Barrett Impulsivity Subscale), 3 = BART, 4 = Eysenck Impulsivity Measures (Including all versions of the Impulsivity Scale and Impulsivity from Eysenck Personality Inventory), 5 = Venturesomeness (Venturesomeness subscales from versions of the Eysenck Impulsivity Scale), 6 = UPPS Lack of Perseverance, 7 = UPPS Lack of Premeditation, 8 = UPPS Urgency, 9 = UPPS Sensation Seeking, 10 = Impulsivity Other Measures (General Impulsivity measures including study specific impulsivity measures and excluding Eysenck measures), 11 = Risk Taking (Scales representing risky behaviour or the propensity to engage in risky behaviour as well as Risky Impulsivity), 12 = Other Sensation Seeking Measures (Study specific Sensation Seeking measures or measures excluding the Zuckerman SSS and the UPPS Sensation Seeking Scale), 13 = SPSRQ/GRAPES Punishment Sensitivity, 14 = SPSRQ/GRAPES Reward Sensitivity, 15 = Delay Discounting, 16 = BAS Drive Subscale from BIS/BAS, 17 = BAS Fun Subscale from BIS/BAS, 18 = BAS Reward Subscale from BIS/BAS, 19 = BIS Total from BIS/BAS, 20= Boredom Susceptibility Subscale of Zuckerman SSS, 21 = Disinhibition Subscale of Zuckerman SSS, 22 = Experience Seeking Subscale of Zuckerman SSS, 23= Thrill and Adventure Seeking Subscale of Zuckerman SSS, 24 = Functional Impulsivity (Dickman Scales), 25 = Dysfunctional Impulsivity (Dickman Scales), 26 = Impulse Control (Measures of the ability to control impulses/urges), 27 = Iowa Gambling Task, 28 = KSP Impulsivity Subscales, 29 = Total of Barrett Impulsivity Scale (BIS Total), 30 = Total of Zuckerman SSS (SSS Total), 31 = BAS Total from BIS/BAS, 32 = TPQ/TCI Reward Dependence, 33 = MPQ/PRF Harm Avoidance, 34 = ZKPQ Impulsive Sensation Seeking (ImpSS), 35 = Social Problem Solving Inventory (SPSI), Impulsive/Careless style score 36, TPQ/TCI Harm Avoidance, 37 = KSP Monotony Avoidance, 38 = Visual-Cognitive Tasks, 39 = Executive response inhibition tasks: Stop Task/Go-no-go task/Stroop tasks/Continuous Performance Test.

Appendix 3 – STM/LTM Index

This section examines your attitudes and your environment. Each question has two statements. Read statements A and B and choose one of the four responses you feel is most true of you.

A) Sex with multiple partners is acceptable.	**OR**		B) Sex should be only with one special person.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Sex without love and commitment is OK.	**OR**		B) Sex should be with someone you care deeply about.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Sex with strangers is OK as long as it is safe and he or she is attractive.	**OR**		B) Sex should only be between couples in a relationship.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I cannot imagine being with only one partner in my lifetime.	**OR**		B) I can see myself settling down romantically with one partner.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Cheating on a partner is OK as long as you are never caught.	**OR**		B) Cheating on a partner is never acceptable under any circumstances.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**

A) Some people find the idea of brief sexual encounters exciting.	**OR**		B) Some people are only interested in long term commitment.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Taking advantage of any opportunity for sex is OK.	**OR**		B) Opportunistic sex is not appropriate.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Long term romantic relationships are not for me.	**OR**		B) I would like to have a romantic relationship that lasts forever.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I would be OK about never settling down with one person in my lifetime.	**OR**		B) I would like to have at least one long term, committed relationship in my lifetime.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) It is good to have short relationships that can easily be ended.	**OR**		B) Relationships should be based on long term commitment.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Variety in sexual partners is more important.	**OR**		B) Finding one special partner is more important.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**

Appendix 4: Factor loadings for Time Preference across groups

Latent Factor	Variable	Full Model	Male	Female	Young	Old
Time Preference	DI	.77	.77	.75	.72	.66
	SS	.50	.50	.69	.53	.77
	FO	-.50	-.50	-.79	-.57	-.78
	DD	-.35	-.35	-.29	-.34	-.13
DI	DI1	.22	.22	.20	.21	.22
	DI2	.26	.26	.32	.29	.24
	DI3	.25	.25	.35	.29	.31
	DI4	.33	.33	.27	.31	.19
	DI5	.21	.21	.24	.22	.19
	DI6	.07	.07	.13	.06	.18
	DI7	.18	.18	.17	.16	.15
	DI8	.35	.35	.37	.34	.30
SS	SS1	.17	.17	.26	.20	.31
	SS2	.25	.25	.31	.30	.32
	SS3	.17	.17	.16	.12	.29
	SS4	.16	.16	.23	.16	.29
	SS5	.30	.29	.29	.22	.27
	SS6	.25	.25	.26	.25	.19
FO	FO1	.36	.36	.42	.42	.42
	FO2	.39	.39	.32	.34	.51
	FO3	.30	.30	.52	.30	.52
	FO4	.25	.25	.11	.23	.33
	FO5	.57	.57	.41	.61	.45
DD	DD	.49	.50	.49	.50	.46

Appendix 5 – Family Instability Scale

This section examines your attitudes and your environment. Each question has two statements. Read statements A and B and choose one of the four responses you feel is most true of you.

A) I am not very close to my mother.	**OR**		B) I am very close to my mother.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I am not very close to my father.	**OR**		B) I am very close to my father.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I do not consider myself close to my family.	**OR**		B) I consider myself very close to my family.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I do not spend time with my parents.	**OR**		B) I always spend time with my parents.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) It is hard to predict when meal times will be.	**OR**		B) Meal times are always predictable.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) My family never eats together.	**OR**		B) My family always eats together.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I often leave home	**OR**		B) I never leave home

without having breakfast.			without having breakfast.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) Most of my meals are not considered healthy.	**OR**		B) Meals are always healthy and well balanced.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I often get away with things at home.	**OR**		B) My family never let me get away with anything.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I can often break rules without being punished.	**OR**		B) I am always punished for breaking rules.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) My parents act differently towards me depending on their mood.	**OR**		B) My parents are consistent in their behaviour towards me.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) My parents change jobs/careers frequently.	**OR**		B) My parents change jobs/careers rarely.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I have lived in lots of different places.	**OR**		B) I rarely/never move house.

A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) I have attended many different secondary schools.	**OR**		B) I have never had to change secondary school.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**
A) There are often different people living in our house.	**OR**		B) The same people live in our house all of time.
A is true of me	**A is sort of true of me**	**B is sort of true of me**	**B is true of me**

References

*Denotes papers used for aggregating data in Paper Four.

Abed, R., Mehta, S., Figueredo, A. J., Aldridge, S., Balson, H., Meyer, C., & Palmer, R. (2012). Eating disorders and intrasexual competition: Testing an evolutionary hypothesis among young women. *The Scientific World Journal, 2012*, 1-8. doi:10.1100/2012/290813

*Abramowitz, A., & Berenbaum, H. (2007). Emotional triggers and their relation to impulsive and compulsive psychopathology. *Personality and Individual Differences*, 43, 1356-1365. doi:10.1016/j.paid.2007.04.004

*Acheson, A., Richards, J.B., & de Wit, H. (2007). Effects of sleep deprivation on impulsive behaviors in men and women. *Physiology & Behavior*, 91, 579-587. doi:10.1016/j.physbeh.2007.03.020

*Adams, C.D., Kelley, M.C., & McCarthy, M. (1997). The Adolescent Behaviour Checklist: Development and initial psychometric properties of a self report measure for adolescents with ADHD. *Journal of Clinical Child Psychology*, 26, 77-86. doi:10.1207/s15374424jccp2601_8

Adams, H.A., Luevano, V.X., & Jonason, P.K. (2014). Risky business: Willingness to be caught in an extra-pair relationship, relationship experience and the dark triad. *Personality and Individual Differences*, 66, 204-207. doi:10.1016/j.paid.2014.01.008

Addison, W. E. (1989). Beardedness as a factor in perceived masculinity. *Perceptual and Motor Skills, 68, 921–922.* doi:*10.2466/pms.1989.68.3.921*

Aggarwal, K. (2013). Sexual desire and sexual activity of men and women across their lifespan. *Indian Journal of Clinical Practice*, 24, 207-210.

*Aidman, E.V., & Kollaras-Mitsinikos, L. (2006). Personality dispositions in the prediction of posttraumatic stress reactions. *Psychological Reports*, 99, 569-580. doi:10.2466/PR0.99.6.569-580

Ainsworth, M.D.S., & Wittig, B.A. (1969). Attachment and the exploratory behaviour of one-year-olds in a strange situation. In Foss, B.M. (Ed.), *Determinants of infant behaviour* (Vol. 4, pp. 113-136), London: Methuen.

Ainsworth, M.D.S., Blehar, M.C., Waters. E., & Wall, S. (1978). *Patterns of attachment: a psychological study of the strange situation*. Erlbaum.

*Aklin, W.M., Lejuez, C.W., Zvolensky, M.J., Kahler, C.W., & Gwadz, M. (2005). Evaluation of behavioural measures of risk taking propensity with inner city adolescents. *Behaviour Research and Therapy*, 43, 215-228. doi:10.1016/j.brat.2003.12.007

*Alexander, F., Allen, C., Brooks, J., Cole, C., & Campbell, A. (2004). Reason to believe: Representations of aggression as phenomenological read-out. *Sex Roles*, 51, 647-659. doi:10.1007/s11199-004-0716-z

Alexander, R. D., Hoogland, J. L., Howard, R. D., Noonan, K. M. & Sherman, P.W. (1979) Sexual dimorphisms and breeding systems in pinnipeds, ungulates, primates, and humans. In Chagnon, N.A & Irons, W. (Eds): *Evolutionary biology and Human Social Behavior*, pp. 402–35. Duxbury Press.

*Allen, T.J., Moeller, F.G., Rhoades, H.M. & Cherek, D.R. (1998). Impulsivity and history of drug dependence. *Drug and Alcohol Dependence*, 50, 137-145. doi:10.1016/S0376-8716(98)00023-4

*Alter, C.E. (2001). Creativity styles and personality characteristics. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 62, (1-B),* 590.

*Aluja, A., & Blanch, A. (2007). Comparison of impulsiveness, venturesomeness and empathy (I-sub-7) structure in English and Spanish samples: Analysis of different structural equation models. *Personality and Individual Differences, 43,* 2294-2305. doi: 10.1016/j.paid.2007.07.019

Aluja, A., & Torrubia, R. (2004). Hostility-aggressiveness, sensation seeking and sex hormones in men: Re-exploring their relationship. Neuropsychobiology, 50, 102-107. doi:10.1159/000077947

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed- TR). Washington, DC: Task Force. doi:10.1176/appi.books.9780890423349

Anderson, C.A., & Bushman, B.J. (2002). Human aggression. *Annual Review of Psychology*, 53, 27-51. doi:10.1146/annurev.psych.53.100901.135231

*Anderson, K.L. (1986). Androgyny, flexibility and individualism. *Journal of Personality Assessment*, 50, 265-278. doi:10.1207/s15327752jpa5002_13

Andersson, M. (1994). *Sexual Selection*. Princeton NJ: Princeton University Press.

Andersson, M. (2005). Evolution of Classical Polyandry: Three Steps to Female Emancipation. *Ethology*, 111, 1–23. doi:10.1111/j.1439-0310.2004.01057.x

*Anestis, M.D., Selby, E.A., & Joiner, T.E. (2007). The role of urgency in maladaptive behaviors. *Behaviour Research and Therapy, 45,* 3018-3029. doi:10.1016/j.brat.2007.08.012

*Antonowicz, D.H. (2002). Hostile attributional biases, driving anger, and roadway aggression among university students: Application of a model of affective aggression. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 63, (4-B),* 2099.

Apicella, C. L., Feinberg, D. R., & Marlowe, F. W. (2007) Voice pitch predicts reproductive success in male hunter gatherers. *Biological Letters,* 3, 682–684. doi.org/10.1098/rsbl.2007.0410

Archer, J. (2004). Sex differences in aggression in real-world settings: A meta-analytic review. *Review of General Psychology, 8,* 291-322. doi:10.1037/1089-2680.8.4.291

Archer, J. (2006). Testosterone and human aggression: An evaluation of the challenge hypothesis. *Neuroscience and Biobehavioral Reviews, 30, 319-335*. doi:10.1016/j.neubiorev.2004.12.007

Archer, J. (2009). Does sexual selection explain human sex differences in aggression? *Behavioral and Brain Sciences*, 32, 266–311. doi:10.1017/ S0140525X09990951.

Archer, J. & Cote, S. (2005) Sex differences in aggressive behavior: A developmental and evolutionary perspective. In Tremblay, R., Hartup, W. W., & Archer, J. (Eds), *Developmental Origins of Aggression* pp. 425–43. Guilford Press.

Archer, J. & Coyne, S.M. (2005). An integrated review of indirect, relational and social aggression. *Personality and Social Psychology Review*, 8, 212-230. doi:10.1207/s15327957pspr0903_2

Archer, J., & Mehdikhani, M. (2003). Variability among males in sexually selected attributes. *Review of General Psychology*, 7, 219-236. doi:10.1037/1089-2680.7.3.219

*Archer, J., & Webb, I.A. (2006). The relation between scores on the Buss-Perry aggression questionnaire and aggressive acts, impulsiveness, competitiveness, dominance and sexual jealousy. *Aggressive Behavior*, 32, 464-473. doi:10.1002/ab.20146

*Archer, J., Kilpatrick, G., & Bramwell, R. (1995). Comparison of two aggression inventories. *Aggressive Behavior*, 21, 371-380. doi:10.1002/1098-2337(1995)21:5<371::AID-AB2480210506>3.0.CO;2-P

Ardila, A. (2008). On the evolutionary origins of executive functions. *Brain and Cognition*, 68, 92-99. doi:10.1016/j.bandc.2008.03.003

Arneklev, B. J., Grasmick, H. G., Tittle, C. R., & Bursik, R. J. (1993). Low self-control and imprudent behavior. *Journal of Quantitative Criminology*, 9, 225–247. doi:10.1007/BF01064461

Arnett, J. (1994). Sensation seeking: A new conceptualization and a new scale. *Personality and Individual Differences, 16*(2), 289-296. doi:10.1016/0191-8869(94)90165-1.

Aubin-Horth, N., Desjardins, J. K., Martei, Y. M., Balshine, S. & Hofmann, H. A. (2007). Masculinized dominant females in a cooperatively breeding species. *Molecular Ecology*, 16, 1349–1358. doi:10.1111/j.1365-294X.2007.03249.x

*Avila, C., & Parcet, M.A. (2000). The role of Gray's impulsivity in anxiety-mediated differences in resistance to extinction. *European Journal of Personality*, 14, 185-198. doi:10.1002/1099-0984(200005/06)14:3<185::AID-PER370>3.3.CO;2-L

*Baca-García, E., Oquendo, M.A. Saiz-Ruiz, J., Mann, J.J., & de Leon, J. (2006). A pilot study on differences in aggression in New York City and Madrid, Spain and their possible impact on suicidal behaviour. *Journal of Clinical Psychiatry*, 67, 375-380. doi:10.4088/JCP.v67n0306

*Baca-Garcia, E., Vaquero, C., Diaz-Sastre, C.,Garcia-Resa, E., Saiz-Ruiz, J., & Fernandez-Piqueras, J. et al. (2004). Lack of association between the serotonin transporter promoter gene polymorphism and impulsivity or aggressive behaviour among suicide attempters and healthy volunteers. *Psychiatry Research*, 126, 99-106. doi:10.1016/j.psychres.2003.10.007

*Bagge, C., Nickell, A., Stepp, S., Durrett, C., Jackson, K., & Trull, T.J. (2004). Borderline personality disorder features predict negative outcomes 2 years later. *Journal of Abnormal Psychology*, 113, 279-288. doi:10.1037/0021-843X.113.2.279

Baig, U., Belsare, P., Watve, M., Jog, M. (2011). Can thrifty gene(s) or predictive fetal programming for thriftiness lead to obesity? *Journal of Obesity*, 861049. doi:10.1155/2011/861049)

Bailey, J.M., Gaulin, S., Agyei, Y., & Gladue, B.A. (1994). Effects of gender and sexual orientation on evolutionarily relevant aspects of human mating psychology. J*ournal of Personality and Social Psychology*, 66, 1081-1093. doi:10.1037/0022-3514.66.6.1081

Baillargeon, R. H., Zoccolillo, M., Keenan, K., Cote´, S., Perusse, D., Wu, H.-X., Boivin, M. & Tremblay, R. E. (2007). Gender differences in physical aggression: A prospective population-based survey of children before and after 2 years of age. *Developmental Psychology*, 43, 13-26. doi:10.1037/0012-1649.43.1.13

*Baker, F., Johnson, M.W., & Bickel, W.K. (2003). Delay discounting in current and never-before cigarette smokers: Similarities and differences across commodity, sign, and magnitude. *Journal of Abnormal Psychology*, 112, 382-392. doi:10.1037/0021-843X.112.3.382

*Baker, J.R., & Yardley, J.K. (2002). Moderating effect of gender on the relationship between sensation seeking-impulsivity and substance use in adolescents. *Journal of Child and Adolescent Substance Abuse*, 12, 27-43. doi:10.1300/J029v12n01_02

Baker, L.A., Jacobson, K.C., Raine, A., Lozano, D.I., & Bezdjian, S. (2007). Genetic and Environmental Bases of Childhood Antisocial Behavior: A Multi-Informant Twin Study. *Journal of Abnormal Psychology,* 116, 219-235. doi:10.1037/0021-843X.116.2.219

Ball, S.A., & Zuckerman, M. (1990). Sensation seeking, Eysenck's personality dimensions and reinforcement sensitivity theory in concept formation. *Personality and Individual Differences, 11,* 343-353. doi:10.1016/0191-8869(90)90216-E

*Balodis, I.M., Johnsrude, I.S., & Olmstead, M.C. (2007). Intact preference conditioning in acute intoxication despite deficient declarative knowledge and working memory. *Alcoholism: Clinical and Experimental Research*, 31, 1800-1810. doi:10.1111/j.1530-0277.2007.00482.x

Band, G.P.H., & van Boxtel, G.J.M. (1999). Inhibitory motor control in stop paradigms: review and reinterpretation of neural mechanisms. *Acta Psychologica, 101,* 179-211. doi:10.1016/S0001-6918(99)00005-0

Barber, N. (2000a). The sex ratio as a predictor of cross-national variation in violent crime. *Cross-Cultural Research*, 34, 264-282. doi:10.1177/106939710003400304

Barber, N. (2000b). On the relationship between country sex ratios and teen pregnancy rates: a replication. *Cross-Cultural Research*, 34, 26–37. doi:10.1177/106939710003400102.

Barber, N. (2001). On the relationship between marital opportunity and teen pregnancy: The sex ratio question. *Journal of Cross-Cultural Psychology*, 32, 259-267. doi:10.1177/0022022101032003001

Barber, N. (2003). The sex ratio and female marital opportunity as historical predictors of violent crime in England, Scotland, and the United States. *Cross Cultural Research*. 37, 373–392. doi:10.1177/1069397103254011

Barber, N. (2009). Countries with fewer males have more violent crime: Marriage markets and mating aggression. *Aggressive Behavior*, 35, 49-56. doi:10.1002/ab.20291

Barber, N. (2011). Marriages and mating aggression help explain societal differences in violent crime. *Aggression and Violent Behavior*, 16, 420-427. doi:10.1016/j.avb.2011.01.001

Barbieri, R.L. (2004). Population density and teen pregnancy. *The American College of Obstetricians and Gynecologists*, 104, 741-744. doi:10.1097/01.AOG.0000139946.11059.be

Barclay, H.J. & Gregory, P.T. (1981). An experimental test of models predicting life history characteristics. *American Naturalist*, 117, 994-961. doi:10.1086%2F283779

*Bare, R.L. (2006). Psychopathic traits in college students: Electrodermal reactivity, anxiety, disinhibition, risk-taking, and executive functioning. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 67, (2-B),* 1140.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg,M. J., & van IJzendoorn,M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin, 133,* 1−24. doi**:**10.1037/0033-2909.133.1.1

Barkley, R.A. (2001). The executive functions and self-regulation: An evolutionary neuropsychological perspective. *Neuropsychology Review, 11*, 1-29. doi:10.1023/A:1009085417776

Barlow, D. H. (2002). *Anxiety and its Disorders: The Nature and Treatment of Anxiety and Panic.* New York: Guilford. doi:10.1016/S1077-7229(03)80027-5

Barratt, E. S. (1985). Impulsiveness subtraits: Arousal and information processing. In J.T. Spence and C.E. Izard (Eds). *Motivation, emotion and personality (pp. 137–146).* Amsterdam: Elsevier Science Publishers.

Bateman, A.J. (1948). Intra-sexual selection in Drosophila. *Heredity*, 2, 349-368. doi:10.1038/hdy.1948.21

*Bates, M.E., & Labouvie, E.W. (1995). Personality-environment constellations and alcohol use: A process oriented study of intraindividual change during adolescence. *Psychology of Addictive Behaviours*, 9, 23-35. doi:10.1037/0893-164X.9.1.23

*Baumeister, R.F., Vohs, K.D., & Tice, D.M. (2007). The strength model of self-control. *Current Directions in Psychological Science*, 16, 351-355. doi:10.1111/j.1467-8721.2007.00534.x

*Bazargan-Hejazi, S., Gaines, T., Duan, N., & Cherpitel, C.J. (2007). Correlates of injury among ED visits: Effects of alcohol, risk perception, impulsivity and sensation seeking behaviors. *American Journal of Drug and Alcohol Abuse*, 33, 101-108. doi:10.1080/00952990601087455

Beattie, G. (2008). *Sex Differences in Driving and Insurance Risk: Understanding the Neurobiological and Evolutionary Foundations of the Differences*. Manchester: University of Manchester

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, 50, 7-15. doi:10.1016/0010-0277(94)90018-*3*

Bechara, A., Damasio, H., Tranel, D., & Damasio, A.R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science*, 275, 1293-1295. doi:10.1126/science.275.5304.1293

Begg, C. B., & Mazumdar, M. (1994). Operating characteristics of a rank correlation test for publication bias. *Biometrics, 50*, 1088-1101. doi:10.2307/2533446

Beike, D.R., Markman, K.D., & Karadogan, F. (2008). What we regret most are lost opportunities: A theory of regret intensity. *Personality and Social Psychology Bulletin*, 35, 385-397. doi:10.1177/0146167208328329

Belsky, J. (1997a) Attachment, mating and parenting: An evolutionary interpretation. *Human Nature*, 8, 361–81. doi:10.1007/BF02913039

Belsky, J. (1997b). Variation in susceptibility to rearing influences: An evolutionary argument. *Psychological Inquiry*, 8, 182–186. doi:10.1207/s15327965pli0803_3

Belsky, J. (2000). Conditional and alternative reproductive strategies: Individual differences in susceptibility to rearing experience. In Rodgers, J., Rowe, D., & Miller, W. (Eds.), *Genetic Influences on Human Fertility and Sexuality: Theoretical and Empirical Contributions from the Biological and Behavioral Sciences* (pp. 127–146). Boston, MA: Kluwer.

Belsky, J. (2005). The developmental and evolutionary psychology of intergenerational transmission of attachment. In Carter, C.S., Ahnert, L., Grossmann, K.E., Hrdy, S.B., Lamb, M.E., Porges, S.W., & Sachser, N. (Eds). *Attachment and Bonding: A New Synthesis*, pp. 169–98.

Belsky, J. (2005). Differential susceptibility to rearing influences: An evolutionary hypothesis and some evidence. In Ellis, B. & Bjorklund, D. (Eds.), *Origins of the Social Mind: Evolutionary Psychology and Child Development* (pp. 139–163). New York: Guilford Press.

Belsky, J. (2007). Childhood experiences and reproductive strategies. In Dunbar, R. & Barrett, L. (Eds.). *Oxford Handbook of Evolutionary Psychology* (pp. 237–254) Oxford: Oxford University Press.

Belsky, J. (2012). The Development of Human Reproductive Strategies: Progress and Prospects. *Current Directions in Psychological Science*, 310-316, doi:10.1177/0963721412453588

Belsky, J. (2014). Toward an evo-devo theory of reproductive strategy, health and longevity: Commentary on Rickard et al. (2014). *Perspective on Psychological Science*, 16-18. doi: 10.1177/1745691613513471

Belsky, J. Steinberg, L., Houts, R. M., & Halpern-Felsher, B. L. & The NICHD Early Child Care Research Network (2010). The development of reproductive strategy in females: Early maternal harshness, early menarche, increased sexual risk taking. *Developmental Psychology*, 46, 120–128. doi:10.1037/a0015549

Belsky, J., & Fearon, R.M.P. (2002). Infant-mother attachment security, contextual risk and early development. *Development and Psychopathology*, 14, 293-310. doi:10.1017/S0954579402002067

Belsky, J., & Pluess, M. (2009). Beyond diathesis–stress: Differential susceptibility to environmental influences. *Psychological Bulletin*, 135, 885–908. doi:10.1037/a0017376

Belsky, J., & Pluess, M. (2013). Beyond risk, resilience and dysregulation: Phenotypic plasticity and human development. *Development and Psychopathology*, 25, 1243-1261. doi:10.1017/S095457941300059X

Belsky, J., Bakermans-Kranenburg, M., & van IJzendoorn, M. (2007). For better and for worse: Differential susceptibility to environmental influences. *Current Directions in Psychological Science*, 16, 305–309. doi:10.1111/j.1467-8721.2007.00525.x

Belsky, J., Schlomer, G. L., & Ellis, B. J. (2012). Beyond cumulative risk: distinguishing harshness and unpredictability as determinants of parenting and early life history strategy. *Developmental Psychology*, 48, 662–673. doi:10.1037/a0024454.

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: an evolutionary theory of socialization. *Child Development*, 62, 647–670. doi:10.1111/j.1467-8624.1991.tb01558.x.

Belsky, J., Steinberg, L., Houts, R. M., Friedman, S. L., DeHart, G., Cauffman, E., Roisman, G. I., Halpern-Felsher, B. L., Susman, E., & the NICHD Early Child Care Research Network (2007). Family rearing antecedents of pubertal timing. *Child Development*, 78, 1302-1321. doi:10.1111/j.1467-8624.2007.01067.x

*Bembenutty, H., & Karabenick, S.A. (1998). Academic delay of gratification. *Learning and Individual Differences*, 10, 329-346. doi:10.1016/S1041-6080(99)80126-5

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588–606. doi:10.1037/0033-2909.88.3.588.

Bentler, P.M. (2005). *EQS6 structural equations manual*. Encino, CA: Multivariate Software.

Bentler, P.M., & Wu, E.J.C. (2002). *EQS for Windows User's Guide.* Encino, CA. Multivariate Software, Inc.

Bereczkei, T., & Csanaky, A. (1996). Evolutionary pathways of child development. *Human Nature*, 7, 257-280. doi:10.1007/BF02733397

Bereczkei, T., & Csanaky, A. (1996). Evolutionary pathways of child development: Lifestyles of adolescents and adults from father-absent families. *Human Nature*, 7, 257-280. doi: 10.1007/BF02733397

Bergdoll, J.R., & Williams, R.W., (1990). Density perception on residential streets. *Berkeley Planning Journal*, 5, 15-38.

Berkowitz, L. (1993). Pain and aggression: some findings and implications. *Motivation and Emotion,* 17, 277-293. doi:10.1007/BF00992223

*Berlin, H.A., Rolls, E.T., & Iversen, S.D. (2005). Borderline personality disorder, impulsivity, and the orbitofrontal cortex. *American Journal of Psychiatry*, 162, 2360-2373. doi:10.1176/appi.ajp.162.12.2360

Bettencourt, B. A., & Miller, N. (1996). Gender differences in aggression as a function of provocation: a meta-analysis. *Psychological Bulletin*, 119, 422–447. doi:10.1037/0033-2909.119.3.422

Beutal, M.E., Stobel-Richter, Y., & Brahler, E. (2008). Sexual desire and sexual activity of men and women across their lifespans: results from a representative German community survey. *BJU International*, 101, 76-82. doi:10.1111/j.1464-410X.2007.07204.x

Bijttebier, P., Beck, I., Claes, L., & Vandereycken, W. (2009). Gray's Reinforcement Sensitivity Theory as a framework for research on personality-psychopathology associations. *Clinical Psychology Review*, 29, 421-430. doi:10.1016/j.cpr.2009.04.002

Biller, H. (1981). Father absence, divorce and personality development. In Lamb, M. (Ed). *The Role of the Father in Child Development* (pp. 319-358). New York Wiley.

*Billieux, J., Rochat, L., Rebetez, M.M.L., & Van der Linden, M. (2008). Are all facets of impulsivity related to self-reported compulsive buying behaviour? *Personality and Individual Differences*, 44, 1432-1442. doi:10.1016/j.paid.2007.12.011

*Bjork, J.M., Hommer, D.W., Grant, S.J., & Danube, C. (2004). Impulsivity in abstinent alcohol-dependent patients: Relation to control subjects and type1-/type 2-like traits. *Alcohol*, 34, 133-150. doi:10.1016/j.alcohol.2004.06.012

Bjorklund, D. J. & Pellegrini, A. D. (2000) Child development and evolutionary psychology. *Child Development*, 71, 1687–708. doi:10.1111/1467-8624.00258

Bjorklund, D.F., & Kipp, K. (1996). Parental investment theory and gender differences in the evolution of inhibition mechanisms. *Psychological Bulletin, 120,* 163-188. doi: 10.1037/0033-2909.120.2.163

Bjorkqvist, K., Osterman, K., & Lagerspetz, K. (1994). Sex differences in covert aggression among adults. *Aggressive Behavior*, 20, 27–33. doi:10.1002/1098-2337(1994)20:1%3C27::AID-AB2480200105%3E3.0.CO;2-Q

Bjorkqvist, K., Lagerspetz, K.M.J. & Kaukiainen, A. (1992). Do Girls Manipulate and Boys Fight? Developmental Trends in Regard to Direct and Indirect Aggression. *Aggressive Behaviour*, 18, 117-128. doi:10.1002/1098-2337(1992)18:2<117::AID-AB2480180205>3.0.CO;2-3

Blackwell, B.S. & Piquero, A.R. (2005). On the relationships between gender, power control, self-control and crime. *Journal of Criminal Justice*, 33, 1-17. doi:10.1016/j.jcrimjus.2004.10.001

Blau, J.R., & Blau, P.M. (1982). The cost of inequality: metropolitan structure and violent crime. *American Sociological Review*, 47, 114-129. doi:10.2307/2095046

Block, J., Block, J. H., & Harrington, D. M. (1974). Some misgivings about the Matching Familiar Figures test as a measure of reflection-impulsivity. *Developmental Psychology, 10,* 611-632. doi:10.1037/h0037047

Bogaert, A.F. (2005). Age at puberty and father absence in a national probability sample. *Journal of Adolescence*, 28, 541-546. doi:10.1016/j.adolescence.2004.10.008

Bogeart, A.F. and Rushton, J.P. (1989). Sexuality, delinquency and r/K reproductive strategies: data from a Canadian university sample. *Personality and Individual Differences*, 10, 1071-1077. doi:10.1016/0191-8869(89)90259-6

Bolland, J. M. (2003). Hopelessness and risk behavior among adolescents living in high poverty inner-city neighbourhoods. *Journal of Adolescence, 26,* 145-158. doi:10.1016/S0140-1971(02)00136-7

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to Meta-Analysis*. John Wiley & Sons, Ltd. doi:10.1002/9780470743386

Borgerhoff Mulder, M. (1990). Kipsigis women's preference for wealthy men: Evidence for female choice in mammals. *Behavioral Ecology and Sociobiology, 27,* 255-264. doi:10.1007/BF00164897

Borgerhoff Mulder, M. (1992).Women's strategies in polygynous marriages. *Human Nature, 3,* 45-70. doi:10.1007/BF02692266

Bouchard, T. (2004). Genetic influences on human psychological traits. *Current Directions in Psychological Science*, 13, 148–151. doi:10.1111/j.0963-7214.2004.00295.x.

Bowlby, J. (1969). *Attachment and Loss, Vol. 1: Attachment*. New York: Basic Books.

Bowlby, J. (1973). *Attachment and Loss, Vol. 2: Separation, anxiety and anger.* New York, Basic Books.

Bowlby, J. (1980). *Attachment and Loss, Vol. 3*. Loss. New York: Basic Books.

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context: I. An evolutionary-developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology*, 17, 271–301. doi:10.1017/S0954579405050145

Boyd, R., Richerson, P.J., & Henrich, J. (2011). The cultural niche: Why social learning is essential for human adaptation. *PNAS*, 108, 10918-10925. doi/10.1073/pnas.1100290108

Brebner, J. (2003). Gender and emotions. *Personality and Individual Differences, 34*, 387-394. doi:10.1016/S0191-8869(02)00059-4

Brennan, I.R., Moore, S.C., & Shepherd, J.P. (2010). Aggression and attitudes to time and risk in weapon using violent offenders. *Psychiatry Research*, 178, 536-539. doi:10.1016/j.psychres.2009.05.006

Brennan, K. A., Clark, C. L. & Shaver, P. R. (1998) Self-report measurement of adult attachment: An integrative overview. In: Simpson, A. & Rholes, W.S. (Eds). *Attachment Theory and Close Relationships*, pp. 46–76. Guilford Press.

Bretherton, I. & Munholland, K. A. (1999) Internal working models in attachment relationships: A construct revisited. In Cassidy, J. & Shaver, P.R. (Eds). *Handbook of Attachment: Theory, research and clinical applications*. Guilford.

Brewster, K. L. (1994a). Neighborhood context and the transition to sexual activity among young black women. *Demography*, 31, 604–614. doi:10.2307/2061794.

Brewster, K.L. (1994b). Race differences in sexual activity among adolescent women: The role of neighbourhood characteristics. *American Sociological Review*, 59, 408-424. doi:10.2307/2095941

Brezina, T., Tekin, E., & Topali, V. (2009). "Might not be a tomorrow": A multimethod approach to anticipated early death and youth crime. *Criminology*, 47, 1091-1129. doi:10.1111/j.1745-9125.2009.00170.x

*Brezo, J., Paris, J., Tremblay, R., Vitaro, F., Zoccolillo, M., & Herbert, M. et al. (2006). Personality traits as correlates of suicide attempts and suicidal ideation in young adults. *Psychological Medicine*, 36, 191-202. doi:10.1017/S0033291705006719

Bro-Jørgensen, J. (2007). Reversed sexual conflict in a promiscuous antelope. *Current Biology*, 17, 2157–2161. doi:10.1016/j.cub.2007.11.026

Bro-Jørgensen, J. (2011). Sexual selection and female competition. In: *eLS*. John Wiley & Sons, Ltd: Chichester. doi:10.1002/9780470015902.a0023305

Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA: Harvard University Press.

Bronfenbrenner, U., & Morris, P.A. (1998). The ecology of developmental processes. In Lerner, R.M. (Ed). *Handbook of Child Psychology: Theoretical Models of Human Development* (5th Ed), 1, 993-1028. New York; Whiley.

Brooks-Gunn, J., Duncan, G.J., Klebanov, P.K., & Sealand, N. (1993). Do neighborhoods affect child and adolescent development? *American Journal of Sociology*, 99, 353-395. doi:10.1086/230268

Brown, G. R., Laland, K. N. & Borgerhoff Mulder, M. (2009). Bateman's principles and human sex roles. *Trends in Ecology and Evolution*. 24, 297–304. doi:10.1016/j.tree.2009.02.005

Brown, M.W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen and J.S. Long (Eds.), *Testing structural equation models* (pp. 136-162). Newbury Park, CA: Sage.

*Brown, S.M., Manuck, S.B., Flory, J.D., & Hariri, A.R. (2006). Neural basis of individual differences in impulsivity: Contributions of corticolimbic circuits for behavioural arousal and control. *Emotion*, 6, 239-245. doi:10.1037/1528-3542.6.2.239

Brown, T.A. (2006). *Confirmatory Factor Analysis for Applied Research*. New York: Guildford Press

Browne, M.W. & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen and J.S. Long (Eds). *Testing Structural Equation Models*, (pp 445-455). Newbury Park, CA: Sage.

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies: a longitudinal test of an evolutionary model. *Human Nature*, 20, 25–51. doi:10.1007/s12110-009-9059-3.

Buehler, C. & Gerard, J. (2002). Marital conflict, ineffective parenting and children's and adolescent's adjustment. *Journal of Marriage and the Family*, 64, 78-92. doi:10.1111/j.1741-3737.2002.00078.x

Burton, L. M. (1990). Teenage childbearing as an alternative life-course strategy in multigenerational black families. *Human Nature*, 1, 123–143. doi:10.1007/BF02692149.

Burton, V. S., Cullen, F. T., Evans, T. D., Alarid, L. F., & Dunaway, R. G. (1998). Gender, self-control, and crime. *Journal of Research in Crime and Delinquency*, 35, 123–147. doi:10.1177/0022427898035002001

Buss, D. M., & Schmitt, D. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological Review, 100*, 204-232. doi:10.1037/0033-295X.100.2.204

Buss, D.M. (2005). *The Murderer Next Door: Why the Mind is Designed to Kill*. New York: Penguin.

Buss, D.M., & Scmitt, D.P. (1993). Sexual strategies theory: an evolutionary perspective on human mating. *Psychological Review*, 100, 204 -232. doi:10.1037/0033-295X.100.2.204

Buunk, A. P., Pollet, T. V., Klavina, L., Figueredo, A. J., & Dijkstra, P. (2009). Height among women is curvilinearly related to life history strategy. *Evolutionary Psychology*, 7, 545–559.

Byrne, B.M. (2001). *Structural Equation Modeling with AMOS: Basic Concepts, Applications and Programming*. New Jersey: Lawrence Erlbaum Associates.

Byrnes, J.P., Miller, D.C., & Schafer, W.D. (1999). Gender differences in risk taking: A meta-analysis. *Psychological Bulletin, 125,* 367–383. doi:10.1037/0033-2909.125.3.367

Cabrera, P., Auslander, W., & Polgar, M. (2009). Future orientation of adolescents in foster care: relationship to trauma, mental health and HIV risk behaviors. *Journal of Child and Adolescent Trauma*, 2, 271-286. doi:10.1080/19361520903317311

*Caci, H., Deschaux, O., & Bayle, F.J. (2007). Psychometric properties of the French versions of the BIS/BAS scales and the SPSRQ. *Personality and Individual Differences*, 42, 987-998. doi:10.1016/j.paid.2006.09.008

*Caci, H., Nadalet, L., Baylé.F.J, Robert, P., & Boyer, P. (2003a). Functional and dysfunctional impulsivity: Contribution to the construct validity. *Acta Psychiatrica Scandinavica*, 107, 34-40. doi:10.1034/j.1600-0447.2003.01464.x

*Caci, H., Nadalet, L., Baylé.F.J, Robert, P., & Boyer, P. (2003b). Cross-cultural study of the Impulsiveness-Venturesomeness-Empathy questionnaire (IVE-7). *Comprehensive Psychiatry*, 44, 381-387. doi:10.1016/S0010-440X(03)00105-6

Cale, E., & Lilienfeld, S.O. (2002). Sex differences in psychopathy and antisocial personality disorder: A review and integration. *Clinical Psychology Review*, 22, 1179–1207. doi:10.1016/S0272-7358(01)00125-8

*Calvete, E., & Cardenoso, O. (2005). Gender differences in cognitive vulnerability to depression and behaviour problems in adolescents. *Journal of Abnormal Child Psychology*, 33, 179-192. doi:10.1007/s10802-005-1826-y

*Camatala, C.D., & Nagoshi, C.T. (1995). Stress, depression, irrational beliefs and alcohol use and problems in a college student sample. *Alcoholism: Clinical and Experimental Research*, 19, 142-146. doi:10.1111/j.1530-0277.1995.tb01482.x

Campbell, A. (1999). Staying alive: Evolution, culture and women's aggression. *Behavioral and Brain Sciences*, 22, 203–252. doi:10.1017/ S0140525X99001818

Campbell, A. (2002). *A Mind of Her Own: The Evolutionary Psychology of Women.* Oxford: Oxford University Press.

Campbell, A. (2005). Aggression. In Buss, D.M. (Ed.). *Handbook of Evolutionary Psychology* (pp. 68 - 95). Hoboken, NJ: Wiley.

Campbell, A. (2006). Sex differences in direct aggression: What are the psychological mediators? *Aggression and Violent Behavior*, 11, 237-264. doi:10.1016/j.avb.2005.09.002

Campbell, A., & Muncer, S. (2009). Can 'risky' impulsivity explain sex differences in aggression? *Personality and Individual Differences*, 47, 402-406. doi:10.1016/j.paid.2009.04.006

Campbell, A., Muncer, S. & Bibel, D. (2001). Women and crime: An evolutionary approach. *Aggression and Violent Behaviour*, 4, 481-497. doi:10.1016/S1359-1789(00)00019-7

Campbell, A., Sapochnik, M., & Muncer, S. (1997). Sex differences in aggression: Does social representation mediate form of aggression? *British Journal of Social Psychology*, 36, 161-171. doi:10.1111/j.2044-8309.1997.tb01125.x

Capaldi, D.M., Crosby, L., & Stoolmiller, M. (1996). Predicting the timing of first sexual intercourse for at risk adolescent males. *Child Development*, 67, 344-359. doi:10.2307/1131818

Card, N.A., Stucky, B.D., Sawalani, G.M., & Little, T.D. (2008). Direct and indirect aggression during childhood and adolescence: A meta-analytic review of gender differences, intercorrelations and relations to maladjustment. *Child Development*, 79, 1185-1229. doi:10.1111/j.1467-8624.2008.01184.x

Carrasco, M.V., Holgado, F.P., Rodriguez, M.A., & del Barrio, M.V. (2009). Concurrent and across time relations between mother/father hostility and children's aggression: a longitudinal study. *Journal of Family Violence*, 24, 213-220. doi:10.1007/s10896-009-9222-y

Carrillo-De-La-Penna, M.T., Otero, J.M., & Romero, E. (1993). Comparison among various methods of assessment of impulsiveness. *Perceptual and Motor Skills*, 77, 567-575. doi:10.2466/pms.1993.77.2.567

Carroll, J.L., Volk, K.D. and Hyde, J.S. (1985). Differences between males and females motives for engaging in sexual intercourse. *Archives of Sexual Behavior*, 14, 131-139. doi:10.1007/BF01541658

Carter, G.L., Campbell, A.C., & Muncer, S. (2014). The dark triad: Beyond a 'male' mating strategy. *Personality and Individual Differences*, 56, 159-164. doi:10.1016/j.paid.2013.09.001

Carver, C. S. (2005). Impulse and constraint: Perspectives from personality psychology, convergence with theory in other areas, and potential for integration. *Personality and Social Psychology Review, 9,* 312–333. doi:10.1207/s15327957pspr0904_2

Carver, C. S., & Scheier, M. F. (1998). *On the self-regulation of behavior*. New York: Cambridge University Press.

Carver, C.S., & White, T.L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS Scales. *Journal of Personality and Social Psychology*, 67, 319-333. doi:10.1037/0022-3514.67.2.319

*Case, S. (2007). Indicators of adolescent alcohol use: A composite risk factor approach. *Substance Use and Misuse, 42,* 89-111. doi: 10.1080/10826080601094280

*Caseras, X., Avila, C., & Torrubia, R. (2003). The measurement of individual differences in Behavioural Inhibition and Behavioural Activation Systems: A comparison of personality scales. *Personality and Individual Differences*, 34, 999-1013. doi:10.1016/S0191-8869(02)00084-3

Casey, B.J., Getz, S. & Galvan, A. (2008). The adolescent brain. *Developmental Review, 28*, 62-77. doi:10.1016/j.dr.2007.08.003

*Casillas, A. (2006). Personality and neuropsychological correlates of impulsivity. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 66, (8-B)*, 4476.

Caspi, A., McClay, J., Moffitt, T.E., Mill, J., Martin, J., et al. (2002). Role of the genotype in the cycle of violence in maltreated children. *Science*, 297, 851-854. doi:10.1126/science.1072290

Celio, M., Karnik, N. S., & Steiner, H. (2006). Early maturation as a risk factor for aggression and delinquency in adolescent girls: a review. *International Journal of Clinical Practice*, 60, 1254–1264. doi:10.1111/j.1742-1241.2006.00972.x.

Center for Wellbeing (n.d.) *TCI: A Comprehensive Assessment of Personality*. Washington University in St. Louis: School of Medicine. http://psychobiology.wustl.edu/7dimensions.html

*Chabrol, H., Montovany, A., Ducongé, E., Kallmeyer, A., Mullet, E., & Leichsenring, F. (2004). Factor structure of the Borderline Personality Inventory in adolescents. *European Journal of Psychological Assessment*, 20, 59–65 doi:10.1027/1015-5759.20.1.59

Chagnon, N.A. (1988). Life Histories, Blood Revenge, and Warfare in a Tribal Population. *Science*, 239, 985-992. doi:10.1126/science.239.4843.985

Charlesworth, B. (1980). *Evolution in age-structured populations*. Cambridge: Cambridge University Press

Charnov, E.L. (1993). *Life History Invariants*. Oxford; Oxford University Press

Charnov, E.L. & Berrigan, D. (1990). Dimensionless numbers and life history evolution: age of maturity versus the adult lifespan. *Evolutionary Ecology*, 4, 273-5. doi.org/10.1007/BF02214335

Chasiotis, A., Scheffer, D., Restemeier, R., & Keller, H. (1998). Intergenerational context discontinuity affects the onset of puberty: A comparison of parent-child dyads in West and East Germany. *Human Nature*, 9, 321-339. doi:10.1007/s12110-998-1008-z

*Chen, A.C.H., Porjesz, B., Rangaswamy, M., Kamarajan, C., Tang, Y., Jones, K.A., et al. (2007). Reduced frontal lobe activity in subjects with high impulsivity and alcoholism. *Alcoholism: Clinical and Experimental Research*, 31, 156-165. doi:10.1111/j.1530-0277.2006.00277.x

Chen, X., Wen, S.W., Fleming, N., Demissie, K., Rhoads, G.C., & Walker, M. (2007). Teenage pregnancy and adverse birth outcomes: a large population based retrospective cohort study. *The International Journal of Epidemiology*, 36, 368-373. doi:10.1093/ije/dyl284

*Cherpital, C.J. (1993). Alcohol, injury and risk taking behavior: Data from a national sample. *Alcoholism: Clinical and Experimental Research*, 17, 762-766. doi:10.1111/j.1530-0277.1993.tb00837.x

Chiappe, D. & MacDonald, K. (2005). The evolution of domain-general mechanisms in intelligence and learning. *The Journal of General Psychology*, 132, 5-40. doi:10.3200/GENP.132.1.5-40

Chisholm, J. S. (1993). Death, hope, and sex: Life-history theory and the development of reproductive strategies. *Current Anthropology*, 34, 1–24. doi:10.1086/204131

Chisholm, J. S. (1996). The Evolutionary Ecology of Attachment Organization. *Human Nature*, 7, 1-37.

Chisholm, J.S. (1999a). *Death, Hope, and Sex: Steps to an Evolutionary Ecology of Mind and Morality.* Cambridge: Cambridge University Press.

Chisholm, J.S. (1999b). Attachment and time preference: Relations between early stress and sexual behaviour in a sample of American university women. *Human Nature*, 10, 51-83. doi:10.1007/s12110-999-1001-1

Chisholm, J., Quinlivan, J. A., Peterson, R.W., & Coall, D. A. (2005). Early stress predicts age at menarche and first birth, adult attachment and expected lifespan. *Human Nature*, 16, 233–265. doi:10.1007/s12110-005-1009-0.

Christakou, A., Halari, R., Smith, A. B., Ifkovits, E., Brammer, M., & Rubia, K. (2009). Sex-dependent age modulation of frontostriatal and temporo-parietal activation during cognitive control. *Neuroimage, 48*, 223-236. doi:10.1016/j.neuroimage.2009.06.070

*Chung, T., & Martin, C.S. (2002). Concurrent and discriminant validity of DSM-IV symptoms of impaired control over alcohol consumption in adolescents. *Alcoholism: Clinical and Experimental Research*, 26, 485-492. doi:10.1111/j.1530-0277.2002.tb02565.x

*Claes, L., Vertommen, H., & Braspenning, N. (2000). Psychometric properties of the Dickman Impulsivity Inventory. *Personality and Individual Differences*, 29, 27-35. doi:10.1016/S0191-8869(99)00172-5

Clark, G. (2007). *A farewell to alms: A brief economic history of the world*. Princeton, NJ: Princeton University Press

Clark, G. & Cummins, N. (2009). Urbanization, mortality and fertility in Malthusian England. *The American Economic Review*, 99, 242-247. doi:10.1257/aer.99.2.242

*Clark, L., Roiser, J.P., Cools, R., Rubinsztein, D.C., Sahakian, B.J., & Robbins, T.W. (2005). Stop signal response inhibition is not modulated by tryptophan depletion or the serotonin transporter polymorphism in healthy volunteers: Implications for the 5-HT theory of impulsivity. *Psychopharmacology*, 182, 570-578. doi:10.1007/s00213-005-0104-6

Clark, L.A., & Watson, D. (1999). Temperament: a new paradigm for trait psychology. In L.A. Pervin & O.P. John (Eds.), *Handbook of Personality; Theory and Research* 2nd Ed., (pp. 399-423). New York: Guildford.

*Clarke, D. (2004). Impulsiveness, locus of control, motivation and problem gambling. *Journal of Gambling Studies*, 20, 319-345. doi:10.1007/s10899-004-4578-7

*Clarke, D. (2006). Impulsivity as a mediator in the relationship between depression and problem gambling. *Personality and Individual Differences*, 40, 5-15. doi:10.1016/j.paid.2005.05.008

*Clift, S.M., Wilkins, J.C., & Davidson, E.A.F. (1993). Impulsiveness, venturesomeness and sexual risk-taking among heterosexual GUM clinic attenders. *Personality and Individual Differences*, 15, 403-410. doi:10.1016/0191-8869(93)90068-E

Cloninger, C.R. (1986). A unified biosocial theory of personality and its role in the development of anxiety states. *Psychiatric Developments, 4*, 167-226.

Cloninger, C.R. (1987). A systematic method for clinical description and classification of personality variants. A proposal. *Archives of General Psychiatry, 44,* 573-88. doi:10.1001/archpsyc.1987.01800180093014

Clutton-Brock, T.H. (1991). *The Evolution of Parental Care.* Princeton, NJ: Princeton University Press.

Clutton-Brock, T.H. (2007). Sexual selection in males and females. *Science*, 318, 1882–1885. doi:10.1126/science.1133311

Clutton-Brock, T.H. (2009). Sexual selection in females. *Animal Behaviour*, 77, 3–11. doi:10.1016/j.anbehav.2008.08.026

Clutton-Brock, T.H., & Vincent, A.C.J. (1991). Sexual selection and the potential reproductive rates of males and females. *Science*, 351, 58-60.

Coall, D.A., & Chisholm, J. (2003). Evolutionary perspectives on pregnancy: maternal age at menarche and infant birth weight. *Social Science & Medicine*, 57, 1771–1781. doi:10.1016/S0277-9536(03)00022-4

Coccaro, E.F., Beresford, B., Minar, P., Kaskow, J., & Geracioti, T. (2007). CSF testosterone: Relationship to aggression, impulsivity, and venturesomeness in adult males with personality disorder. *Journal of Psychiatric Research*, 41, 488-492. doi:10.1016/j.jpsychires.2006.04.009

*Colder, C.R., & Stice, E. (1998). A longitudinal study of the interactive effects of impulsivity and anger on adolescent problem behavior. *Journal of Youth and Adolescence, 27,* 255-274. doi:10.1023/A:1022889202419

Colom, R., Contreras, J., Shih, P. C., & Santacreu, J. (2003). The assessment of spatial ability with a single computerized test. *European Journal of Psychological Assessment,* 19, 92-100. doi:10.1027//1015-5759.19.2.92.

*Colom, R., Escorial, S., Shih, P.C., & Privado, J. (2007). Fluid intelligence, memory span, and temperament difficulties predict academic performance of young adolescents. *Personality and Individual Differences*, 42, 1503-1514. doi:10.1016/j.paid.2006.10.023

*Compton, M.T., & Kaslow, N.J. (2005). Self-reported psychotic symptoms predict impulsivity among African-American patients in an urban non-psychiatric medical setting. *Psychiatry Research*, 135, 35-44. doi:10.1016/j.psychres.2005.03.004

Congdon, E., Canli, T. (2008). A neurogenetic approach to impulsivity. *Journal of Personality*, 76, 1447-1484. doi:10.1111/j.1467-6494.2008.00528.x.

Conners, C.K. (2000). *Conner's Continuous Performance Test (CPT II).* North Tonawanda, NY: Multi-Health Systems.

*Cooper, M. L., Agocha, V. B., & Sheldon, M.S. (2000). A motivational perspective on risky behaviors: The role of personality and affect regulatory processes. *Journal of Personality*, 68, 1059-1088. doi:10.1111/1467-6494.00126

*Cooper, M.L., Wood, P.K; Orcutt, H.K. & Albino, A. (2003). Personality and the predisposition to engage in risky or problem behaviors during adolescence. *Journal of Personality and Social Psychology*, 84, 390-410. doi:10.1037/0022-3514.84.2.390

*Copping, L.T. (2007). Social class and social representation: Is impulsivity the mediator? *Unpublished Dissertation*: University of Durham.

Copping, L.T., Campbell, A., & Muncer, S. (2013a). Violence, teenage pregnancy and life history: Ecological factors and their impact on strategy driven behaviour. *Human Nature*, 24, 137-157. doi: 10.1007/s12110-013-9163-2

Copping, L.T., Campbell, A., & Muncer, S. (2013b). Impulsivity, sensation seeking and reproductive behaviour: A life history perspective. *Personality and Individual Differences*, 54, 908-912. doi:10.1016/j.paid.2013.01.003

Copping, L.T., Campbell, A., & Muncer, S. (2014). Psychometrics and life history strategy: the structure and validity of the high K strategy scale. *Evolutionary Psychology*, 12, 200-222.

Copping, L.T., & Campbell, A. (Under Review a). The environment and life history strategies: Neighbourhood and individual-level models. *Evolution and Human Behavior*

Copping, L.T., Campbell, A., & Muncer, S. (In press). Conceptualizing time preference: A life-history analysis. *Evolutionary Pscyhology*.

*Corr, P.J., Pickering, A.D., & Gray, J.A. (1995). Sociability/impulsivity and caffeine arousal: Critical flicker/fusion frequency and procedural learning. *Personality and Individual Differences*, 18, 713-730. doi:10.1016/0191-8869(95)00001-M

*Corulla, W.J. (1987). Psychometric investigation of the Eysenck Personality Questionnaire (Revised) and its relationship to the I7 Impulsiveness Questionnaire. *Personality and Individual Differences*, *8*, 651-658. doi:10.1016/0191-8869(87)90062-6

Costa, P. T., Jr., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. J*ournal of Personality and Social Psychology*, 81, 322–331. doi:10.1037/0022-3514.81.2.322

Costa, P.T., & McCrae, R.R. (1992*). Revised NEO Personality Inventory (NEO PI-R) and NEO Five Factor Inventory (NEO-FFI): Professional manual.* Odessa, FL: Psychological Assessment Resources.

Cote, S.M., Vaillancourt, T., Barker, E.D., Nagin, D., & Tremblay, R.E. (2007). The joint development of physical and indirect aggression: Predictors of continuity and change during childhood. *Development and Psychopathology*, 19, 37-55. doi:10.10170S0954579407070034

Coulton, C. J., Korbin, J. E., Su, M., & Chow, J. (1995). Community level factors and child maltreatment rates. *Child Development*, 66, 1262–1276. doi:10.1111/j.1467-8624.1995.tb00934.x.

Cox, C.R., & La Boeuf, B.J. (1977). Female incitation of male competition: a mechanism of sexual selection. *American Naturalist*, 111, 317-335. doi:10.1086/283163

Crean, J.P., de Wit, H. & Richards, J.B. (2000). Reward discounting as a measure of impulsive behavior in a psychiatric outpatient population. *Experimental and Clinical Psychopharmacology, 8,* 155-162. doi:10.1037/1064-1297.8.2.155

Crick, N.R., & Grotpeter, J.K. (1995). Relational aggression, gender and social-psychological adjustment. *Child Development*, 66, 710-722. doi:10.2307/1131945

*Cross, C.P. (2007, September). *Risky impulsivity predicts sexual and aggressive behaviour in undergraduates.* Poster presented at the meeting of the Association for the Study of Animal Behaviour, Newcastle University.

*Cross, C.P. (2008, March). *Individual differences in sexual and aggressive behaviour: the role of risky impulsivity.* Paper presented at the first biennial conference of the International Family Aggression Society, University of Central Lancashire.

*Cross, C.P. (2009). *Sex differences in aggression and sociosexuality: the role of risky impulsivity.* Manuscript submitted for publication.

Cross, C.P., Copping, L.T., & Campbell, A. (2011). Sex differences in impulsivity: a meta-analysis. *Psychological Bulletin*, 137, 97-130. doi:10.1037/a0021591

Cross, S. E., & Madson, L. (1997). Models of the self: Self-construals and gender. *Psychological Bulletin*, 122, 5-37. doi:10.1037/0033-2909.122.1.5

Cummings, J.L. (1993). Frontal-subcortical circuits and human behaviour. *Archives of Neurology*, 50, 873-880. doi:10.1001/archneur.1993.00540080076020

Cunradi. C.B., Caetano, R., Clark, C. & Scafer, J. (2000). Neighbourhood poverty as a predictor of intimate partner violence among white, black, and Hispanic couples in the United States: a multilevel analysis. *Annals of Epidemiology*, 10, 297-308. doi:10.1016/S1047-2797(00)00052-1

*Curran, M.F. (2006). Risk taking as a contributing factor to driving while under the influence of alcohol. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 67, (3-B),* 1741.

*Curry, L.A. (2005). Affect, decision making, and adolescent risk behavior. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 65, (12-B),* 6685.

*Curry, T.R., & Piquero, A.R. (2003). Control ratios and defiant acts of deviance: Assessing additive and conditional effects with constraints and impulsivity. *Sociological Perspectives*, 46, 397-415. doi:10.1525/sop.2003.46.3.397

*Cyders, M.A, Smith, G.T., Spillane, N.S., Fischer, S., Annus, A.M., & Peterson, C. (2007). Integration of impulsivity and positive mood to predict risky behaviour: Development and validation of a measure of positive urgency. *Psychological Assessment*, 19, 107-118. doi:10.1037/1040-3590.19.1.107

*d'Acremont, M., & Van der Linden, M. (2005). Adolescent impulsivity: Findings from a community sample. *Journal of Youth and Adolescence*, 34, 427-435. doi:10.1007/s10964-005-7260-1

*Dahlen, E.R., Martin, R.C., Ragan, K., & Kuhlman, M.M. (2004). Boredom proneness in anger and aggression: Effects of impulsiveness and sensation seeking. *Personality and Individual Differences*, 37, 1615-1627. doi:10.1016/j.paid.2004.02.016

*Dahlen, E.R., Martin, R.C., Ragan, K., & Kuhlman, M.M. (2005). Driving anger, sensation seeking, impulsiveness, and boredom proneness in the prediction of unsafe driving. *Accident Analysis and Prevention*, 37, 341-348. doi:10.1016/j.aap.2004.10.006

Daitzman, R .J. & Zuckerman, M. (1980) Disinhibitory sensation seeking, personality, and gonadal hormones. *Personality and Individual Differences 1,* 103-110. doi:10.1016/0191-8869(80)90027-6

Dalley, J.W., Mar, A.C., Economidou, D. & Robbins, T.W. (2008). Neurobehavioral mechanisms of impulsivity: Fronto-striatal systems and functional neurochemistry. *Pharmacology, Biochemistry and Behavior*, *90*, 250-260. doi:10.1016/j.pbb.2007.12.021

Daly M., & Wilson, M. (1983). *Sex, evolution and behavior: Adaptations for reproduction.* Boston, MA: Willard Grant Press.

Daly M., & Wilson, M. (1988) *Homicide.* New York: Aldine de Gruyter.

Daly, M. & Wilson, M. (1990). Killing the competition: Female/female and male/male homicide. *Human Nature,* 1, 81–107. doi:10.1007/BF02692147

*Davelaar, P.M., Araujo, F.S., & Kipper, D.A. (2008). The Revised Spontaneity Assessment Inventory (SAI-R): Relationship to goal orientation, motivation, perceived self-efficacy and self-esteem. *The Arts in Psychotherapy*, 35, 117-128. doi:10.1016/j.aip.2008.01.003

Davidson, R.J., Jackson, D.C., & Kalin, N.H. (2000). Emotion, plasticity, context, and regulation: Perspectives from affective neuroscience. *Psychological Bulletin*, 126, 890-909. doi:10.1037/0033-2909.126.6.890

Davidson, R.J., Putnam, K.M., & Larson, C.L. (2000). Dysfunction in the neural circuitry of emotion regulation: A possible prelude to violence. *Science*, 289, 591-594. doi:10.1126/science.289.5479.591

*Davis, C., Patte, K., Tweed, S., & Curtis, C. (2007). Personality traits associated with decision-making deficits. *Personality and Individual Differences,* 42, 279-290. doi:10.1016/j.paid.2006.07.006

*Davis, R.A., Flett, G.L., & Besser, A. (2002).Validation of a new scale for measuring problematic Internet use: Implications for pre-employment screening. *CyberPsychology & Behavior*, 5, 331-345. doi:10.1089/109493102760275581

Dawe, S., Gullo, M. J., & Loxton, N. J. (2004). Reward drive and rash impulsiveness as dimensions of impulsivity: Implications for substance misuse. *Addictive Behaviors*, 29, 1389–1405. doi:10.1016/j.addbeh.2004.06.004

Day, R.D. (1992). The transition to first intercourse among racially and culturally diverse youth. *Journal of Marriage and the Family*, 54, 749-762. doi:10.2307/353158

*De Flores, T., & Valdes, M. (1986). Behaviour pattern A: Reward, fight or punishment? *Personality and Individual Differences*, 7, 319-326. doi:10.1016/0191-8869(86)90007-3

de La Rochebrochard, E. (2000). Age at puberty of girls and boys in France: measurements from a survey on adolescent sexuality. *Population: An English Selection*, 12, 51-79.

de Muinck Keizer-Schrama, S. M. P. F., & Mul, D. (2001). Trends in pubertal development in Europe. *Human Reproduction Update*, 7, 287–291. doi:10.1093/humupd/7.3.287

*de Wit, H., Engasser, J.L., & Richards, J.B. (2002). Acute administration of d-amphetamine decreases impulsivity in healthy volunteers. *Neuropsychopharmacology*, 27, 813-825. doi:10.1016/S0893-133X(02)00343-3

*de Wit, H., Flory, J.D., Acheson, A., McCloskey, M., & Manuck S.B. (2007). IQ and nonplanning impulsivity are independently associated with delay discounting in middle-aged adults. *Personality and Individual Differences, 42*, 111-121. doi:10.1016/j.paid.2006.06.026

*Deffenbacher, J.L., Filetti, L.B., Richards, T.L., Lynch, R.S., & Oetting, E.R. (2003). Characteristics of two groups of angry drivers. *Journal of Counselling Psychology*, 50, 123-132. doi:10.1037/0022-0167.50.2.123

Degenhardt, L., Chiu, W.T., Sampson, N., Kessler, R.C., Anthony, J.C., Angermeyer, M., et al. (2008) Toward a global view of alcohol, tobacco, cannabis, and cocaine use: Findings from the WHO World Mental Health Surveys. *PLoS Medicine, 5*,1053-1067. e141. doi:10.1371/journal.

Del Giudice, M. (2008). Sex-biased ratio of avoidant/ambivalent attachment in middle childhood. *British Journal of Developmental Psychology*, 26, 369-379.

Del Giudice, M. (2009a). Sex, attachment and the development of reproductive strategies. *Behavioral and Brain Sciences*, 32, 1-67. doi:10.1017/S0140525X09000016

Del Giudice, M. (2009b). On the real magnitude of psychological sex differences. *Evolutionary Psychology*, 7, 264-279.

Del Giudice, M. (2011). Sex differences in romantic attachment: a meta-analysis. *Personality and Social Psychology Bulletin*, 37, 193-214. doi:10.1177/0146167210392789

Del Giudice, M. (2012). Sex ratio dynamics and fluctuating selection on personality. *Journal of Theoretical Biology*, 297, 48-60. doi:10.1016/j.jtbi.2011.12.004

Del Giudice, M. (2014a). Life history plasticity in humans: the predictive value of early cues depends on the temporal structure of the environment. *Proceedings of the Royal Society B: Biological Sciences*, 281. doi:10.1098/rspb.2013.2222

Del Giudice, M. (2014b). Early stress and human behavioural development: emerging evolutionar perspectives. *Journal of Developmental Origins of Health and Disease*, 5, 270-280. doi:10.1017/S2040174414000257

Del Giudice, M., & Belsky, J. (2010). Sex differences in attachment emerge in Miidle childhood: an evolutionary hypothesis. *Child Development Perspectives*, 4, 97-105. doi:10.1111/j.1750-8606.2010.00125.x

Del Giudice, M., & Ellis, B. J. (in press). Evolutionary foundations of developmental psychopathology. In Chicchetti, D. (Ed.), *Developmental Psychopathology, Vol. 1: Theory and method* (3rd ed.). New York: Wiley.

Del Giudice, M., Angeleri, R., & Manera, V. (2009). The juvenile transition: a developmental switch point in human life history. *Developmental Review*, 29, 1-31. doi:10.1016/j.dr.2008.09.001

Del Giudice, M., Ellis, B. J., & Shirtcliff, E. A. (2011). The adaptive calibration model of stress responsivity. *Neuroscience & Biobehavioral Reviews*, 35, 1562–1592. doi:10.1016/j.neubiorev.2010.11.007

Del Giudice, M., Hinnant, J.B., Ellis, B.J., El-Sheikh, M. (2012). Adaptive patterns of stress responsivity: a preliminary investigation. *Developmental Psychology*, 48, 775–790. doi:10.1037/a0026519

*DePasquale, J.P., Geller, E.S., Clarke, S.W., & Littleton, L.C. (2001). Measuring road rage: Development of the Propensity for Angry Driving Scale. *Journal of Safety Research*, 32, 1-16. doi:10.1016/S0022-4375(00)00050-5

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, 22, 491–569. doi:10.1017/S0140525X99002046

Depue, R.A., & Collins, P.F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioural and Brain Sciences*, 22, 491-569. doi:10.1017/S0140525X99002046

Derefinko, K., DeWall, C.N., Metze, A.V., Walsh, E.C., & Lynam, D.R. (2011). Do different facets of impulsivity predict different types of aggression? *Aggressive Behavior, 37,* 223-233. doi:10.1002/ab.20387.

Derryberry, D., & Rothbart, M.K. (1997). Reactive and effortful processes in the organization of temperament. *Development and Psychopathology*, 9, 633-652. doi:10.1017/S0954579497001375

Deschenes, E.P., & Esbensen, F.A. (1999). Violence and gangs: Gender differences in perception and behavior. *Journal of Quantitative Criminology, 15,* 63-96. doi:10.1023/A:1007552105190

*Dhuse, S.R. (2006). Consequences of binge drinking: Risk and protective factors. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 67, (1-B),* 537.

*Diaz, A., & Pickering, A.D. (1993). The relationship between Gray's and Eysenck's personality spaces. *Personality and Individual Differences*, 15, 297-305. doi:10.1016/0191-8869(93)90220-W

Dickman, S., & Meyer, D. E. (1988). Impulsivity and speed-accuracy tradeoffs in information processing. *Journal of Personality and Social Psychology*, 54, 274-290. doi:10.1037/0022-3514.54.2.274

Dickman, S.J. (1990). Functional and dysfunctional impulsivity: Personality and cognitive correlates. *Journal of Personality and Social Psychology*, 58, 95-102. doi:10.1037/0022-3514.58.1.95

Diem, C., & Pizarro, J.M. (2010). Social structure and family homicides. *Journal of Family Violence*, 25, 521-532. doi:10.1007/s10896-010-9313-9

Dillon, H.M., & Adair, L.E., Wang, Z., & Johnson, Z. (2013). Slow and steady wins the race: Life history, mate value and mate settling. *Personality and Individual Differences*, 55, 612-618. doi:10.1016/j.paid.2013.05.015

*Dinn, W.M, Harris, C.L., Aycicegi, A., Greene, P., & Andover, M.S. (2002). Positive and negative schizotypy in a student sample: Neurocognitive and clinical correlates. *Schizophrenia Research*, 56, 171-185. doi:10.1016/S0920-9964(01)00230-4

Dishion, T. J., Ha, T., & Ve´ronneau, M. H. (2012). An ecological analysis of the effects of deviant peer clustering on sexual promiscuity, problem behavior, and childbearing from early adolescence to adulthood: An enhancement of the life history framework. *Developmental Psychology*, 48, 703–717. doi:10.1037/a0027304

DiStefano, C. (2002). The impact of categorization with confirmatory factor analysis. *Structural Equation Modeling: A Multidisciplinary Journal*, 9, 327-346. doi:10.1207/S15328007SEM0903_2

Dobrin, A., Lee, D., & Price, J. (2005). Neighborhood structure differences between homicide victims and non-victims. *Journal of Criminal Justice*, 33, 137–143. doi:10.1016/j.jcrimjus.2004.12.005.

Dodge, K. A., Bates, J. E., & Pettit, G. S. (1990). Mechanisms in the cycle of violence. *Science*, 250, 1678-1683. doi:10.1126/science.2270481

Donohew, L., Zimmerman, R., Cupp, P. S., Novak, S., Colon, S., & Abell, R. (2000). Sensation seeking, impulsive decision making, and risky sex: Implications for risk-taking and design of interventions. *Personality and Individual Differences*, 28, 1079–1091. doi:10.1016/S0191-8869(99)00158-0

*Doran, N., McChargue, D., & Cohen, L. (2007a). Impulsivity and the reinforcing value of cigarette smoking. *Addictive Behaviors*, 32, 90-98. doi:10.1016/j.addbeh.2006.03.023

*Doran, N., Spring, B., & McChargue, D. (2007b). Effect of impulsivity on craving and behavioural reactivity to smoking cues. *Psychopharmacology*, 194, 279-288. doi:10.1016/j.addbeh.2006.03.023

Dorn, L. D., & Chrousos, G. P. (1997). The neurobiology of stress: Understanding regulation of affect during female biological transitions. *Seminars in Reproductive Endocrinology*, 15, 19–35. doi:10.1055/s-2008-1067965

Dorn, L. D., Dahl, R. E.,Woodward, H. R., & Biro, F. (2006). Defining the boundaries of early adolescence: A user's guide to assessing pubertal status and pubertal timing in research with adolescents. *Applied Developmental Science*, 10, 30–56. doi.org/10.1207/s1532480xads1001_3

Dougherty, D.M., Mathias, C.W., Marsh-Richard, D.M., Furr, R.M., Nouvion, S.O., & Dawes, M.A. (2009). Distinctions in behavioral impulsivity: Implications for substance abuse research. *Addictive Disorders and their Treatment*, 8, 61-73. doi:10.1097/ADT.0b013e318172e488

Draper, P. (1989). African marriage systems: Perspectives from evolutionary ecology. *Ethology and Sociobiology, 10*, 145-169. doi:10.1016/0162-3095(89)90017-4

Draper, P., & Harpending, H. (1982). Father absence and reproductive strategy–an evolutionary perspective. *Journal of Anthropological Research*, 38, 255–273.

*Driscoll, H., Zinkivskay, A., Evans, K., & Campbell, A. (2006). Gender differences in social representations of aggression: The phenomenological experience of differences in inhibitory control? *British Journal of Psychology*, 97, 139-153. doi:10.1348/000712605X63073

Dunkel, C. S. (2012). Do self-report measures of life history strategy exhibit the hypothesized differences between blacks and whites predicted by differential K theory? *Personality and Individual Differences*, 51, 759-761. doi:10.1016/j.paid.2011.12.035

Dunkel, C. S., & Decker, M. (2010). Convergent validity of measures of life-history strategy. *Personality and Individual Differences*, 48, 681-684. doi:10.1016/j.paid.2009.12.014

Dunkel, C. S., Kim, J. K., & Papini, D. R. (2012). The general factor of psychosocial development and its relation to the general factor of personality and life history strategy. *Personality and Individual Differences*, 52, 202-206. doi:10.1016/j.paid.2011.10.016

Dunkel, C.S. & Mathes, E. (2011). The Effect of Individual Differences and Manipulated Life Expectancies on the Willingness to Engage in Sexual Coercion. *Evolutionary Psychology*, 9, 588-599.

Dunkel, C. S., Mathes, E., & Harbke, C. (2011). Life history strategy, identity consolidation and psychological wellbeing. *Personality and Individual Differences*, 51, 34-38. doi:10.1016/j.paid.2011.03.005

Dunkel, C. S., Mathes, E., & Papini, D. R. (2010). The effect of life expectancy on aggression and generativity: A life history perspective. *Evolutionary Psychology*, 8, 492–505.

Dunkel, C.S. & Beaver, K.M. (2013). Life history and the general theory of crime: Life expectancy effects on low self control and criminal intent. *Journal of Social, Evolutionary, and Cultural Psychology*, 7, 12-23. doi:10.1037/h0099177

Dunson, D.B., Colombo, B., & Baird, D.D. (2001). Changes with age in the level and duration of fertility in the menstrual cycle. *Human Reproduction*, 17, 1399-1403.

Duntley, J. D., and Buss, D. M. (2004). The evolution of evil. In A. G. Miller (Ed.), *The social psychology of good and evil*, (pp. 102–123). New York: Guilford.

DuRant, R. H., Cadenhead, C., Pendergrast, R. A., Slavens, G., & Linder, C. W. (1994). Factors associated with the use of violence among urban black adolescents. *American Journal of Public Health*, 84, 612–617. doi:10.2105/AJPH.84.4.612.

*Durante, M. (2002). A logistic regression analysis of biodata and personality predictors of job retention among detention officers. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 63, (5-B), 2579.

Durham, W.H. (1991). *Coevolution: Genes, Culture and Human Diversity*. Stanford: Stanford University press

D'Zurilla, T. J., & Nezu, A. M. (1990). Development and preliminary evaluation of the Social Problem-Solving Inventory. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*, 2, 156-163. doi:10.1037/1040-3590.2.2.156

D'Zurilla, T., Nezu, A. & Maydeu-Olivares, A. (1996). *Manual for the social problem-solving inventory–Revised*. North Tonawanda, NY: Multi-Health Systems.

*D'Zurilla, T.J., Maydeu-Olivares, A., & Kant, G.L. (1998). Age and gender differences in social problem-solving ability. *Personality and Individual Differences*, 25, 241-252. doi:10.1016/S0191-8869(98)00029-4

Eagly, A., & Steffen, V. (1986). Gender and aggressive behavior: a meta-analytic review of the social psychological literature. *Psychological Bulletin*, 100, 309–330. doi:10.1037/0033-2909.100.3.309

Eaton, S.B., Konner, M., & Shostak, M. (1988). Stone agers in the fast lane: chronic degenerative diseases in an evolutionary perspective. *American Journal of Medicine*, 84, 739-749. doi:10.1016/0002-9343(88)90113-1

Eisenberg, J.F. (1981) *The Mammalian Radiations: An Analysis of Trends in Evolution, Adaptation, and Behavior*. University of Chicago Press, Chicago.

Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M., Cumberland, A., Shepard, S. A., et al. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development*, 75, 25–46. doi:10.1111/j.1467-8624.2004.00652.x

Ellis, B. J. (2004). Timing of pubertal maturation in girls: an integrated life history approach. *Psychological Bulletin*, 130, 920–958. doi:10.1037/0033-2909.130.6.920

Ellis, B.J., Bates, J.E., Dodge, K.A., Fergusson, D.M., Horwood, L.J., Pettit, G.S., & Woodward, L. (2003). Does father absence place daughters at special risk for early sexual activity and teenage pregnancy? *Child Development*, 74, 801-821. doi:10.1111/1467-8624.00569

Ellis, B.J., Del Giudice, M., Dishion, T.J., Figueredo, A.J., Gray, P., Griskevicius, V., Hawley, P.H., Jacobs, W.J., James, J., & Wilson, D.S. (2012). The evolutionary basis of risky adolescent behaviour: Implications for science, policy and practice. *Developmental Psychology*, 48, 598-623. doi:10.1037/a0026220

Ellis, B. J., & Essex, M. J. (2007). Family environments, adrenarche and sexual maturation: A longitudinal test of a life history model. *Child Development*, 78, 1799–1817. doi:10.1111/j.1467-8624.2007.01092.x.

Ellis, B. J., Essex, M. J., & Boyce, W. T. (2005). Biological sensitivity to context: II. Empirical explorations of an evolutionary-developmental theory. *Development and Psychopathology*, 17, 303–328. doi:10.1017/S0954579405050157

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. The impact of harsh versus unpredictable environments on the evolution and development of life history strategies. *Human Nature*, 20, 204–268. doi:10.1007/s12110-009-9063-7.

Ellis, B. J., & Garber, J. (2000). Psychosocial antecedents of variation in girls' pubertal timing: Maternal depression, stepfather presence, and marital and family stress. *Child Development*, 71, 485 – 501. doi:10.1111/1467-8624.00159

Ellis, B. J., McFadyen-Ketchum, S., Dodge, K. A., Pettit, G. S., & Bates, J. E. (1999). Quality of early family relationships and individual differences in the timing of pubertal maturation in girls: A longitudinal test of an evolutionary model. *Journal of Personality and Social Psychology*, 77, 387–401. doi:10.1037/0022-3514.77.2.387

Ellis, L. (1987). Criminal behaviour and r/K selection: An extension of gene based evolutionary theory. *Personality and Individual Differences*, 9, 697-708.

Ellis, L. (1988). Criminal behaviour and r/K selection: an extension of gene-based evolutionary theory. *Personality and Individual Differences*, 9, 697–708. doi:10.1080/01639625.1987.9967739

Ellis, L. (1989). Sex hormones and r/K selection, and victimful criminality. *The Mankind Quarterly*, 29, 329-340.

Ellison, P. T. (2001). *On fertile ground: A natural history of human reproduction*. Cambridge, MA:

Else-Quest, N.M., Hyde, J.S., Goldsmith, H.H., & Van Hulle, C.A. (2006). Gender differences in temperament: A meta analysis. *Psychological Bulletin*, 132, 33-72. doi:10.1037/0033-2909.132.1.33

Elster, A.B., Lamb, M.E., Peters, L., Kahn, J & Tavare, J. (1987). Judicial involvement and conduct problems of fathers of infants born to adolescent mothers. *Pediatrics*, 79, 230-234

England and Wales National Census (2001). Data retrieved January 2008 from http://neighbourhood.statistics.gov.uk/dissemination/LeadHome.do;jsessionid=ac1f930bce610859f68cf5746e4bcdc872d1de81eee.e38PbNqOa3qRe3iPchmRc3mLa41ynknvrkLOlQzNp65In0?bhcp=1.

England and Wales National Census (2011). Data retrieved June 2013 from http://neighbourhood.statistics.gov.uk/dissemination/LeadHome.do;jsessionid=ac1f930bce610859f68cf5]746e4bcdc872d1de81eee.e38PbNqOa3qRe3iPchmRc3mLa41ynknvrkLOlQzNp65In0?bhcp=1.

*Enticott, P.G., Ogloff, J.R.P., & Bradshaw, J.L. (2006). Associations between laboratory measures of executive inhibitory control and self-reported impulsivity. *Personality and Individual Differences*, 41, 285-294. doi:10.1016/j.paid.2006.01.011

*Epstein, J.N., Erkanli, A., Conners, C.K., Klaric, J., Costello, J.E., & Angold, A. (2003a). Relations between Continuous Performance Test performance measures and ADHD behaviors. *Journal of Abnormal Child Psychology*, 31, 543-554. doi:10.1023/A:1025405216339

*Epstein, L.H., Richards, J.B., Saad, F.G., Paluch, R.A., Roemmich, J.N., & Lerman, C. (2003b). Comparison between two measures of delay discounting in smokers. *Experimental and Clinical Psychopharmacology*, 11, 131-138. doi:10.1037/1064-1297.11.2.131

Evans, G., & English, K. (2002). The environment of poverty. *Child Development*, 73, 1238-1248. doi:10.1111/1467-8624.00469

Evans, J. (2008). Dual-procession accounts of reasoning, judgement and social cognition. *Annual Review of Psychology, 59*, 255-78. doi:10.1146/annurev.psych.59.103006.093629

Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology*, 146, 348–361. doi.org/10.1007/PL00005481.

Eysenck, H.J., & Eysenck, M.W. (1985). *Personality and individual differences: A natural science approach.* New York: Plenum Press.

Eysenck, H.J., & Eysenck, S.B.G. (1968). *Manual for the Eysenck Personality Inventory*. San Diego: Educational and Industrial Testing Service.

Eysenck, H.J., & Gudjonsson, G.H. (1989). *The causes and cures of criminality.* New York: Plenum.

Eysenck, S. B. G., & Eysenck, H. J. (1978). Impulsiveness and venturesomeness: Their position in a dimensional system of personality description. *Psychological Reports*, 43, 1247-1255. doi:10.2466/pr0.1978.43.3f.1247

*Eysenck, S.B.G. (1981). Impulsiveness and antisocial behaviour in children. *Current Psychological Research*, 1, 31-37. doi:10.1007/BF02684423

*Eysenck, S.B.G., & Abdel-Khalek, A.M. (1992). Cross cultural comparisons of the I7 Impulsiveness Scales for Egyptian and English adults. *European Journal of Psychological Assessment*, 8, 149-153.

*Eysenck, S.B.G., & Jamieson, R.N. (1986). A cross cultural study of personality: American and English children. *Journal of Social Behavior and Personality*, 1, 199-208.

*Eysenck, S.B.G., Daum, I., Schugens, M.M., & Diehl, J.M. (1990). A cross cultural study of impulsiveness, venturesomeness and empathy: Germany and England. *Zeitschrift Fur Differentielle Und Diagnostiche Psychologie*, 11, 209-213.

*Eysenck, S.B.G., Pearson, P.R., Easting, G., & Allsopp, J.F. (1985). Age norms for impulsiveness, venturesomeness and empathy in adults. *Personality and Individual Differences*, 6, 613-619. doi:10.1016/0191-8869(85)90011-X

Eysenck, S.G.B. (1993). The I7: Development of a measure of impulsivity and its relationship to the superfactors of personality. In McCown, W.G., Johnson, J.L., & Shure, M.B. (Eds) .*The Impulsive Client: Theory, Research and Treatment.* (pp. 141-149). American Psychological Association, Washington, D.C.

Fabio, A., Tu, L., Loeber, R., & Cohen, J. (2011). Neighbourhood socioeconomic disadvantage and the shape of the age-crime curve. *American Journal of Public Health*, 101, 325-332. doi: 10.2105/AJPH.2010.300034

*Fallgatter, A.J., & Herrmann, M.J. (2001). Electrophysiological assessment of impulsive behavior in healthy subjects. *Neuropsychologia*, 39, 328-333. doi:10.1016/S0028-3932(00)00115-9

Farley F. H. and Farley S. V. (1972) Stimulus-seeking motivation and delinquent behavior among institutionalised delinquent girls. *Journal of Consulting and Clinical Psychology*, 39, 94-97. doi:10.1037/h0033204

Farley, F.H. (1973). A theory of delinquency. *Paper presented at the Annual Meeting of the American Psychological Association*. Montreal; Quebec.

Farrington, D. P., Loeber, R., & van Kammen, W. B. (1990). Long-term criminal outcomes of hyperactivity–impulsivity–attention deficit and conduct problems in childhood. In Robins, L.N. & Rutter, M. (Eds.). *Straight and Devious Pathways from Childhood to Adulthood* (pp. 62–81). Cambridge, England: Cambridge University Press.

Fawcett, T.W., McNamara, J.M., & Houston, A.I. (2012). When is it adaptive to be patient? A general framework for evaluating delayed rewards. *Behavioural Processes*, 89, 128-136. doi:10.1016/j.beproc.2011.08.015

Feinberg, D. R. (2008). Are human faces and voices ornaments signalling common underlying cues to mate value? *Evolutionary Anthropology*, 17, 112-118. doi:10.1002/evan.20166.

Feingold, A. (1994). Gender differences in personality: A meta-analysis. *Psychological Bulletin*, 116, 429–456. doi:10.1037/0033-2909.116.3.429

*Feldman, D.J. (1999). Haste and disinhibition: An analysis of impulsive cognitive style manifest in adult performance on neuropsychological measures. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 59,* (11-B), 6063

Feldman, S.S., & Brown, N.L. (1993). Family influences on adolescent male sexuality: The mediational role of self-restraint. *Social Development*, 2, 15-35. doi:10.1111/j.1467-9507.1993.tb00002.x

Feldmeyer, B. & Steffensmeier, D. (2007). Elder Crime: Patterns and Trends, 1980-2004. *Research on Aging*, 29, 297-322. doi:10.1177/0164027507300802

Fernandes, H. B. F., & Woodley, M. A. (2013). Strategic differentiation and integration among the 50 states of the USA. *Personality and Individual Differences*, 55, 1000–1002. doi:10.1016/j.paid.2013.07.463

Fiedler, K. (1954). Vergleichende Verhaltensstudien an Seenadeln, Schlangennadeln und Seepferdchen (Syngnathidae). *Zeitsch, Tierpsych*, 11, 358-416.

Figueredo, A. J., Andrzejczak, D. J., Jones, D. N., Smith-Castro, V., & Montero-Rojas, E. (2011). Reproductive strategy and ethnic conflict: Slow life history as a protective factor against negative ethnocentrism in two contemporary societies. *Journal of Social, Evolutionary, and Cultural Psychology*, 5, 14–31.

Figueredo, A. J., Cabeza de Baca, T., & Woodley, M. A. (2013). The measurement of human life history strategy. *Personality and Individual Differences*, 55, 251–255. doi:10.1016/j.paid.2012.04.033

Figueredo, A.J., Cuthbertson, A.M., Kauffman, I.A., Weil, E. & Gladden, P.R. (2012). The interplay of behavioral dispositions and cognitive abilities: sociosexual orientation, emotional intelligence, executive functions and life history strategy. *Temas em Psicologia*, 20, 87-100.

Figueredo, A.J., & Gladden, P.R. (2007). Genetic variance and strategic pluralism. *European Journal of Personality*, 21, 597-599.

Figueredo, A.J., & Jacobs, W.J. (2010). Aggression, risk-taking, and alternative life history strategies: The behavioral ecology of social deviance. In Frias-Armenta, M. & Corral-Verdugo, V. (Eds.), *Biopsychosocial Perspectives on Interpersonal Violence*. Hauppauge, NY: Nova Science Publishers, in press.

Figueredo, A. J., & Rushton, J. P. (2009). Evidence for shared genetic dominance between the general factor of personality, mental and physical health, and life history traits. *Twin Research and Human Genetics*, 12, 555–563. doi:10.1375/twin.12.6.555

Figueredo, A.J., Sefcek, J.A., Vasquez, G., Brumbach, B.H., King, J.E., & Jacobs, W.J. (2005). Evolutionary personality psychology. In D. M. Buss (Ed.), *Handbook of Evolutionary Psychology* (pp. 851-877). Hoboken, NJ: Wiley.

Figueredo, A. J., Sefcek, J. A., Vásquez, G., Brumbach, B. H., King, J. E., & Jacobs, W. J. (2005). Evolutionary personality psychology. In Buss D.M. (Ed.). *Handbook of Evolutionary Psychology* (pp. 851–877). Hoboken, NJ: Wiley.

Figueredo, A. J., Vásquez, G., Brumbach, B. H., & Schneider, S. M. R. (2004). The heritability of life history strategy: The K-factor, covitality, and personality. *Social Biology*, 51, 121-134.

Figueredo, A.J., Vasquez, G., Brumbach, B.H. and Schneider, S.M.R. (2007). The k-factor, covitality and personality: a psychometric test of life history theory. *Human Nature*, 18, 47-73. doi:10.1007/BF02820846

Figueredo, A. J., Vásquez, G., Brumbach, B. H., & Schneider, S. M. R., Sefcek, J.A., Tal, I.R., Hill, D., Wenner, C.J. & Jacobs, W.J. (2006). Consilience and Life History Theory: From Genes to Brain to Reproductive Strategy. *Developmental Review*, 26, 243–275. doi:10.1016/j.dr.2006.02.002

Figueredo, A. J., & Wolf, P. S. A. (2009). Assortative pairing and life history strategy: A cross-cultural study. *Human Nature*, 20, 317–330. doi:10.1007/s12110-009-9068-2

Figueredo, A. J., Wolf, P. S. A., Gladden, P. R., Olderbak, S. G., Andrzejczak, D. J., & Jacobs, W. J. (2010). Ecological approaches to personality. In Buss, D.M. & Hawley, P.H. (Eds.*), The Evolution of Personality and Individual Differences* (pp. 210–239). New York, NY: Oxford University Press.

Figueredo, A.J., MacDonald, K., Wenner, C., & Howrigan, D. (2007). *Executive functions, general intelligence, life history and temperament.* Paper presented at the Annual Meeting of the International Society for Intelligence Research, Amsterdam, The Netherlands.

Figueredo, A.J., Wolf, P.S.A., Olderbak, S.G., Gladden, P.R., Fernandes, H.B.F., Wenner, C., Hill, D., Andrzejczak, D.J., Sisco, M.M., Jacobs, W.J., Hohman, Z.J., Sefcek, J.A., Kruger, D., Howrigan, D.P., MacDonald, K., Rishton, J.P. (2014). The Psychometric Assessment of Human Life History Strategy: A Meta-Analytic Construct Validation. *Evolutionary Behavioral Sciences*, 8, 148-185. doi:10.1037/h0099837

Figueredo, A.J., Woodley, M.A., Brown, S.D., & Ross, K.C. (2013). Multiple successful tests of the strategic differentiation-integration effort (SD-IE) Hypothesis. *Journal of Social, Evolutionary, and Cultural Psychology*, 7, 361-383.

*Fingeret, M.C., Moeller, F.G., & Stotts, A. (2005). Gender differences among MDMA users on psychological and drug history. *Addictive Disorders and Their Treatment*, 4, 43-48. doi:10.1097/01.adt.0000146604.18946.97

Fischer, A.H., & Manstead, A.S.R. (2000). Gender and emotions in different cultures. In Fischer, A.H. (Ed.) *Gender and Emotion: Social Psychological Perspectives* (pp. 71-94). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511628191

*Fischer, S., & Smith, G.T. (2004). Deliberation affects risk taking beyond sensation seeking. *Personality and Individual Differences*, 36, 527–537 doi:10.1016/S0191-8869(03)00112-0

*Flannery, D.J., Vazsonyi, J.T., Torquati, J., & Fridrich, A. (1994). Ethnic and gender differences in risk for early adolescent substance use. *Journal of Youth and Adolescence*, 23, 195-213. doi:10.1007/BF01537445

*Flora, R.L. (2007). Behavioral undercontrol and alcohol consumption. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, *68*, (1-B), 620.

*Flory, J.D., Harvey, P.D., Mitropoulou,V., New, A.S., Silverman, J.M., Siever, L.J., et al. (2006). Dispositional impulsivity in normal and abnormal samples. *Journal of Psychiatric Research*, 40, 438-447. doi:10.1016/j.jpsychires.2006.01.008

Fonagy, P. (1996). The significance of the development of metacognitive control over mental representations in parenting and infant development. *Journal of Clinical Psychoanalysis*, 5, 67-86.

*Ford, C.M. (1995). Psychosocial correlates of contraceptive and HIV/STD preventive behaviors among college students. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, *55*, (10-B), 4590.

Ford, W.C.L., North, K., Taylor, H., Farrow, A., Hull, M.G.R., Golding, J. & ALSPAC Study Team (2000). Increasing paternal age is associated with delayed conception in a large population of fertile couples: evidence for declining fecundity in older men. *Human Reproduction*, 15, 1703–1708. doi:10.1093/humrep/15.8.1703

Forsberg, A. J. L. & Tullberg, B. S. (1995). The relationship between cumulative number of cohabiting partners and number of children for men and women in modern Sweden. *Ethology and Sociobiology* 16, 221–32. doi:10.1016/0162-3095(95)00003-4

*Fossati, A., Barratt, E.S., Acquarini, E., & Di Ceglie, A. (2002). Psychometric properties of an adolescent version of the Barratt Impulsiveness Scale-11 for a sample of Italian high school students. *Perceptual and Motor Skills*, 95, 621-635. doi: 10.2466/pms.2002.95.2.621

Fossati, A., Barratt, E.S., Borroni, S., Villa, D., Grazioli, F., Maffei, C. (2007). Impulsivity, aggressiveness and DSM-IV personality disorders. *Psychiatry Research*, 149, 157-167. doi:10.1016/j.psychres.2006.03.011

*Fossati, A., Barratt, E.S., Carretta, I., Leonardi, B., Graziolia, F., & Maffeia, C. (2004). Predicting borderline and antisocial personality disorder features in nonclinical subjects using measures of impulsivity and aggressiveness. *Psychiatry Research*, 125, 161–170. doi:10.1016/j.psychres.2003.12.001

*Fossati, A., Ceglie, A.Di., Acquarini, E., & Barratt, E.S. (2001). Psychometric properties of an Italian version of the Barratt Impulsiveness Scale-11 (BIS-11) in nonclinical subjects. *Journal of Clinical Psychology*, 57, 815-828. doi:10.1002/jclp.1051

Fowles, D.C. (1987). Application of a behavioural theory of motivation to the concepts of anxiety and impulsivity. *Journal of Research in Personality*, 21, 417-436. doi:10.1016/0092-6566(87)90030-4

Fowles, D.C. (1988). Psychophysiology and psychopathology: A motivational approach. *Psychophysiology*, 25, 373-391. doi:10.1111/j.1469-8986.1988.tb01873.x

*Fox, H.C., Axelrod, S.R., Paliwal, P., Sleeper, J., & Sinha, R. (2007). Difficulties in emotion regulation and impulse control during cocaine abstinence. *Drug and Alcohol Dependence*, 89, 298-301. doi:10.1016/j.drugalcdep.2006.12.026

Fraley, R. C. (2002) Attachment stability from infancy to adulthood: Meta-analysis and dynamic modeling of developmental mechanisms. *Personality and Social Psychology Review*, 6, 123–51. doi:10.1207/S15327957PSPR0602_03

Frank, E. (Ed.) (2000). *Gender and its effects on psychopathology.* Arlington, VA: American Psychiatric Press.

Franken, I.H.A., & Muris, P. (2006). Gray's impulsivity dimension: A distinction between reward sensitivity versus rash impulsiveness. *Personality and Individual Differences*, 40, 1337-1347. doi:10.1016/j.paid.2005.11.016

*Franken, I.H.A., Nijs, I., & Van Strien, J.W. (2005). Impulsivity affects mismatch negativity (MMN) measures of preattentive auditory processing. *Biological Psychology*, 70, 161-167. doi:10.1016/j.biopsycho.2005.01.007

Frankenhuis, W. E., & Panchanathan, K. (2011). Individual differences in developmental plasticity may result from stochastic sampling. *Perspectives on Psychological Science*, 6, 336 –347. doi:10.1177/1745691611412602

Frederick, S., Loewenstein, G., & O'Donoghue, T. (2002). Time discounting and time preference: a critical review. *Journal of Economic Literature*, 40, 351-401. doi:10.1257/002205102320161311

*Fu, A-T., Ko, H-C., Wu, J.Y-W., Cherng, B-L., & Cheng, C-P. (2007). Impulsivity and expectancy in risk for alcohol use: Comparing male and female college students in Taiwan. *Addictive Behaviors*, 32, 1887-1896. doi:10.1016/j.addbeh.2007.01.003

Fuster, J.M. (1997). *The prefrontal cortex: Anatomy, physiology and neuropsychology.* Philadelphia: Lippincott-Raven.

Gage, A.J. (1998). Sexual activity and contraceptive use: the components of the decision making process. *Studies in Family Planning*, 29, 154-166. doi:10.2307/172156

Gagnon, J. H. (1977). *Human sexualities*. Glenview, IL: Scott, Foresman

Galanti, K., Gluck, M.E., & Geliebter, A. (2007). Test meal intake in obese binge eaters in relation to impulsivity and compulsivity. *International Journal of Eating Disorders*, 40, 727-732. doi:10.1002/eat.20441

Galvan, A., Hare, T., Voss, H., Glover, G., & Casey, B. J. (2007). Risk-taking and the adolescent brain: Who is at risk? *Developmental Science*, 10, F8 – F14. doi:10.1111/j.1467-7687.2006.00579.x

Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioral and Brain Sciences*, 23, 573–587. doi:10.1017/S0140525X0000337X

Gangestad, S.W. & Simpson, J.A. (1990). Toward an evolutionary history of female sociosexual variation. *Journal of Personality*, 58, 69-96. doi:10.1111/j.1467-6494.1990.tb00908.x

Gardner, W. (1993). A life-span rational-choice theory of risk taking. In Bell, N. & Bell, R. (Eds), *Adolescent Risk Taking*. Newbury Park: Sage Publications.

*Gargallo, B. (1993). Basic variables in reflection-impulsivity: A training programme to increase reflectivity. *European Journal of Psychology of Education*, 8, 151-167. doi:10.1007/BF03173159

*Garland, T.A. (1999). The relationship between the diagnosis of ADHD in adults, gender and sensation seeking. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 60, (5-B),* 2338.

Gatzke-Kopp, L.M., Raine, A., Loeber, S., Stouthamer-Loeber, M., & Steinhauer, S.R. (2002). Serious Delinquent Behavior, Sensation-Seeking and Electrodermal Arousal. *Journal of Abnormal Child Psychology, 30*, 477-486. doi:10.1023/A:1019816930615

Gavrilets, S. (2012). Human origins and the transition from promiscuity to pair-bonding. *Proceedings of the National Academy of Sciences*, 109, 9923-9928. doi:10.1073/pnas.1200717109

Gawryszewski, V.P., & Costa, L.S. (2005). Social inequality and homicide rates in Sau Paulo City, Brazil. *Rev Saúde Pública*, 39, 1-6. doi:10.1590/S0034-89102005000200008

Ge, X., Conger, R.D., & Elder, G.H. (1996). Coming of Age Too Early: Pubertal Influences on Girls' Vulnerability to Psychological Distress. *Child Development*, 67, 3386-3400. doi:10.2307/1131784

Geary, D.C. (1998). *Male, Female*. Washington: American psychological Association.

Gerbing, D.W., Ahadi, S.A., & Patton, J.H. (1987). Toward a conceptualization of impulsivity: Components across the behavioural and self-report domains. *Multivariate Behavioral Research*, 22, 357-379. doi:10.1207/s15327906mbr2203_6

Geronimus, A.T. (1992). Teenage childbearing and social disadvantage: unprotected discourse. *Family Relations*, 41, 244-248. doi:10.2307/584840

Geronimus, A.T. (1996). What teen mothers know. *Human Nature*, 7, 323–352. doi:10.1007/BF02732898.

Gershon, J., & Gershon, J. (2002). A meta-analytic review of gender differences in ADHD. *Journal of Attention Disorders*, 5, 143-154. doi:10.1177/108705470200500302

*Giancola, P.R., & Parrott, D.J. (2005). Differential effects of past-year stimulant and sedative drug use on alcohol-related aggression. *Addictive Behaviors*, 30, 1535-1554. doi:10.1016/j.addbeh.2005.02.011

Gibson, C.L. & Tibbetts, S.G. (2000). A biosocial interaction in predicting early onset offending. *Psychological Reports*, 86, 509-518. doi:10.2466/PR0.86.2.509-518

Giedd, J. N., Clasen, L. S., Lenroot, R., Greenstein, D., Wallace, G. L., Ordaz, S., et al. (2006). Puberty-related influences on brain development. *Molecular and Cellular Endocrinology*, 254, 154-162. doi:10.1016/j.mce.2006.04.016

Gilbert, P. (1998). The evolved basis and adaptive functions of cognitive distortions. *British Journal of Medical Psychology*, 71, 447-463. doi:10.1111/j.2044-8341.1998.tb01002.x

Giosan, C. (2013). 'Slow' reproductive strategy: a negative predictor of depressive symptomatology. *Australian Journal of Psychology*, 1-7. doi: 10.1111/ajpy.12016

Giosan, C. & Wyka, K. (2009). Is a successful high-K fitness strategy associated with better mental health? *Evolutionary Psychology*, 7, 28-39.

Giosan, C. (2006). High-K strategy scale: A measure of the high-K independent criterion of fitness. *Evolutionary Psychology, 4*, 394-405.

Gladden, P. R., Figueredo, A. J., & Jacobs, W. J. (2008). Life history strategy, psychopathic attitudes, personality, and general intelligence. *Personality and Individual Differences*, 46, 270–275.

Gladden, P. R., Figueredo, A. J., & Snyder, B. (2010). Life history strategy and evaluative self-assessment. *Personality and Individual Differences*, 48, 731–735. doi:10.1016/j.paid.2010.01.016

Gladden, P.R., Sisco, M. and Figueredo, A.J. (2008). Sexual coercion and life-history strategy. *Evolution and Human Behavior*, 29, 319-326. doi:10.1016/j.evolhumbehav.2008.03.003.

Gladden, P.R., Welch, J., Figeuredo, A.J. & Jacobs, W.J. (2009). Moral intuitions and religiosity as spuriously correlated life history traits. *Journal of Evolutionary Psychology*, 7, 167-184. doi:10.1556/JEP.7.2009.2.5.

*Glicksohn, J., & Nahari, G. (2007). Interacting personality traits? Smoking as a test case. *European Journal of Personality*, 21, 225-234. doi:10.1002/per.609

Goldstein, J.M., Seidman, L.J., Horton, N.J., Markris, N., Kennedy, D.N., Caviness, V.S., et al. (2001). Normal sexual dimorphism of the adult human brain assessed in vivo magnetic resonance imaging. *Cerebral Cortex*, 11, 490-497. doi:10.1093/cercor/11.6.490

Gomez, R. & Gomez, A. (2005). Convergent, discriminant and concurrent validities of measures of the behavioural approach and behavioural inhibition systems: Confirmatory factor analytic approach. *Personality and Individual Differences*, 38, 87–102. doi:10.1016/j.paid.2004.03.011

Goodman, A., Koupil, I. & Lawson, D.W. (2012). Low fertility increases descendant socioeconomic position but reduces long term fitness in a modern post-industrial society. *Proceedings of the Royal Society B: Biological Sciences*, 279, 4342-4351. doi:10.1098/rspb.2012.1415

Gottfredson, M.R. & Hirschi, T. (1990). *A General Theory of Crime*. Stanford: Stanford University Press

*Goudriaan, A.E., Grekin, E.R., & Sher, J. (2007). Decision making and binge drinking: A longitudinal study. Alcoholism: *Clinical and Experimental Research*, 31, 928-938. doi:10.1111/j.1530-0277.2007.00378.x

Grafen, A. (1984). Natural selection, kin selection and group selection. In, Krebs, J.R., & Davies, N.B. (Eds). *Behavioural Ecology: An Evolutionary Approach*, 2nd edition, pp. 62–84. Blackwell Scientific, Oxford.

*Grano, N., Keltikangas-Jarvinen, L., Kouvonen, A., Puttonen, S., Viartanen, M., Vahtera, J., et al. (2007). Association of impulsivity with sleep duration and insomnia in an employee population. *Personality and Individual Differences*, 43, 307-318. doi:10.1016/j.paid.2006.11.022

Grasmick, H.G., Tittle, C.R., Bursik, R.J., & Arneklev, B.J. (1993). Testing the core empirical implications of Gottfredson and Hirschi's general theory of crime. *Journal of Research in Crime and Delinquency*, 30, 5-29. doi:10.1177/0022427893030001002

Grauer, A. L. & Stuart-Macadam, P. (1998) *Sex and gender in paleopathological perspective. Cambridge University Press.*

Gray, J. A. (1970). The psychophysiological basis of introversion-extraversion. *Behaviour Research and Therapy*, 8, 249−266. doi:10.1016/0005-7967(70)90069-0

Gray, J. A. (1972). The psychophysiological basis of introversion– extraversion: A modification of Eysenck's theory. In Nebylitsyn, V.D. & Gray, J.A. (Eds.), *The Biological Bases of Individual Behaviour (pp. 182–205). New York: Academic.*

Gray, J. A. (1994). Personality dimensions and emotion systems. In Ekman, P. & Davidson, R.J. (Eds.), *The Nature of Emotion: Fundamental Questions* (pp. 329–331). New York: Oxford University Press.

Gray, J. A., & McNaughton, N. (2000). *The Neuropsychology of Anxiety: An Enquiry into the Functions of the Septo-Hippocampal System.* Oxford: Oxford University Press.

*Green, F.W. (1995). Trait impulsivity and sexual behaviors related to HIV transmission. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 56, (1-B), 557.

Griskevicius, V., Delton, A. W., Robertson, T. E., & Tybur, J. M. (2011). Environmental contingency in life history strategies: The influence of mortality and socioeconomic status on reproductive timing. *Journal of Personality and Social Psychology*, 100, 241–254. doi:10.1037/a0021082

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. *Journal of Personality and Social Psychology*, 100, 1015-1026. doi:10.1037/a0021082.

Grumbach, M. M., & Styne, D. M. (2003). Puberty: Ontogeny, neuroendocrinology, physiology and disorders. In Larsen, P.R., Kronenberg, H. M., Melmed, S.M., & Polonsky, K.S. (Eds.), *Williams Textbook of Endocrinology* (10th ed.). Philadelphia: Saunders.

*Gudjonsson, G.H., Einarsson, E., Bragason, O.O., & Sigurdsson, J.F. (2006). Personality predictors of self-reported offending in Icelandic students. *Psychology, Crime and Law*, 12, 383-393. doi:10.1080/10683160500056929

*Gupta, U., & Gupta, B.S. (1998). Environmental schematization in men and women and its relation to certain personality variables**.** *Journal of the Indian Academy of Applied Psychology*, *24*, 99-104.

Guttentag, M., & Secord, P. F. (1983). *Too Many Women: The Sex Ratio Question*. Beverly Hills: Sage.

Haldre, K., Rahu, K., Rahu, M., & Karro, H. (2009). Individual and familial factors associated with teenage pregnancy: an interview study. *European Journal of Public Health*, 19, 266-270. doi:10.1093/eurpub/ckn143

Hall, J. A. (1984). *Nonverbal sex differences: Communication accuracy and expressive style*. Baltimore: Johns Hopkins University Press.

Hallet, T.B., Lewis, J.J.C., Lopman, B.A., Nyamukapa, C.A., Mushati, P., Wambe, M., Garnett, G.P., & Gregson, S. (2007). Age at first sex and HIV infection in rural Zimbabwe. *Studies in Family Planning*, 38, 1-10. doi:10.1111/j.1728-4465.2007.00111.x

Hansen, K. (2003). Education and the crime-age profile. *British Journal of Criminology*, 43, 141-168. doi:10.1093/bjc/43.1.141

Happanay, K., Zelazo, P.D., & Stuss, D.T. (2004). Development of orbitofrontal function: Current themes and future directions. *Brain and Cognition*, 55, 1-10. doi:10.1016/j.bandc.2004.01.001

Hardy, R. J., & Thompson, S. G. (1998). Detecting and describing heterogeneity in meta-analysis. *Statistics in Medicine*, 17, 841-856. doi:10.1002/(SICI)1097-0258(19980430)17:8<841::AID-SIM781>3.0.CO;2-D

Harris, C. R., Jenkins, M., & Glaser, D. (2006). Gender differences in risk assessment: Why do women take fewer risks than men? *Judgment and Decision Making Journal*, 1, 48-63

Hartman, M.L., & Rawson, H.E. (1992). Differences in and of correlates of sensation seeking in male and female athletes and non-athletes. *Personality and Individual Differences*, 13, 805-812. doi:10.1016/0191-8869(92)90054-S

Haselton, M.G., & Buss, D.M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology*, 78, 81-91. doi:10.1037/0022-3514.78.1.81

*Hawton, K., Rodham, K., Evans, E., & Weatherall, R. (2002). Deliberate self harm in adolescents: Self report survey in schools in England. *British Medical Journal*, 325, 1207-1211. doi:10.1136/bmj.325.7374.1207

*Heaven, P.C.L. (1989). Orientation to authority and its relation to impulsiveness. *Current Psychology: Research and Reviews*, 8, 38-45. doi:10.1007/BF02686736

*Heaven, P.C.L. (1991). Venturesomeness, impulsiveness and Eysenck's personality dimensions: A study among Australian adolescents. *Journal of Genetic Psychology*, 152, 91-99. doi:10.1080/00221325.1991.9914681

Heavey, E.J., Moysich, K.B., Hyland, A., Druschel, C.M., & Sill, M.W. (2008). Differences in pregnancy desire among pregnant female adolescents at a state-funded family planning clinic. *Journal of Midwifery and Womens Health*, 53, 130-137. doi:10.1016/j.jmwh.2007.09.005

Hedges, L. V., & Nowell, A. (1995). Sex differences in mental test scores, variability, and numbers of high scoring individuals. *Science*, 269, 41–45. doi:10.1126/science.7604277

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis.* London: Academic Press.

Hedges, L. V., & Pigott, T. D. (2004). The power of statistical tests for moderators in meta-analysis. *Psychological Methods*, 9, 426-445. doi:10.1037/1082-989X.9.4.426

*Heerey, E.A., Robinson, B.M., McMahon, R.R., & Gold, J.M. (2007). Delay discounting in schizophrenia. Cognitive Neuropsychiatry, 12, 213-221. doi:10.1080/13546800601005900

Helmers, K.F., Young, S.N. & Pihl, R.O. (1995). Assessment of measures of impulsivity in healthy male volunteers. *Personality and Individual Differences*, 19, 927-935. doi:10.1016/S0191-8869(95)00107-7

*Henle, C.A. (2005). Predicting workplace deviance from the interaction between organizational justice and personality. *Journal of Managerial Issues*, 17, 247-263.

Henrich, J., & Broesch, J. (2011). On the nature of cultural transmission networks: Evidence from Fijian villages for adaptive learning biases. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 366, 1139–1148.

Henrich, J., & McElreath, R. (2007). Dual-inheritance theory: the evolution of human cultural and cultural evolution. In Dunbar, R.I.M., & Barrett, L. (Eds*). The Oxford Handbook of Evolutionary Psychology*. Oxford: Oxford University Press.

*Herba., C.M., Tranah, T., Rubia, K., & Yule, W. (2006). Conduct problems in adolescence: Three domains of inhibition and effect of gender. *Developmental Neuropsychology*, 30, 659-695. doi:10.1207/s15326942dn3002_2

Herman-Giddens, M. E., Slora, E., Wasserman, R. C., Bourdony, C., Bhapkar, M., Koch, G. G., et al. (1997). Secondary sexual characteristics and menses in young girls seen in office practice. A study of the Pediatric Research in Office Settings Network. *Pediatrics*, 99, 505–512. doi:10.1542/peds.99.4.505

Hetherington, E.M. (1972). Effects of Father Absence on Personality Development in Adolescent Daughters. *Developmental Psychology*, 7, 313-326. doi:10.1037/h0033339

*Hewlett, P., & Smith, A. (2006). Correlates of daily caffeine consumption. *Appetite*, 46, 97-99. doi:10.1016/j.appet.2005.10.004

Heym, N., Ferguson, E., & Lawrence, C. (2008). An evaluation of the relationship between Gray's revised RST and Eysenck's PEN: Distinguishing BIS and FFFS in Carver and White's BIS/BAS scales. *Personality and Individual Differences*, 45, 709−715. doi:10.1016/j.paid.2008.07.013

Higgins, J. P. T. (2008). Heterogeneity in meta-analysis should be expected and appropriately quantified. *International Journal of Epidemiology*, 37, 1158-1160. doi:1158-1160.10.1093/ije/dyn204

Higgins, J. P. T., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine*, 21, 1539-1558. doi:10.1002/sim.1186

Hill, E. M., Jenkins, J., & Farmer, L. (2008). Family unpredictability, future discounting and risk taking. *The Journal of Socio-Economics*, 37, 1381–1396. doi:10.1016/jsocec.2006.12.081.

Hill, E. M., Ross, L. T., and Low, B. S. (1997). The role of future unpredictability in human risk-taking. *Human Nature*, 8, 287-325. doi:10.1007/BF02913037

Hill, G.E. (1991). Plumage colouration is a sexually selected indicator of male quality. *Nature*, 350, 337-339. doi:10.1038/350337a0

Hill, K., & Hurtado, A.M. (1996*). Ache life-history: The ecology and demography of a foraging people*. New York : Aldine de Gruyter.

Hockaday, C., Crase, S.J., Shelley, M.C., & Stockdale, D.F. (2000). A prospective study of adolescent pregnancy. *Journal of Adolescence*, 23, 423-438. doi:10.1006/jado.2000.0329

Hodges-Simeon, C.R., Gaulin, S.J.C., & Puts, D.A. (2011). Voice correlates of mating success in men: Examining "contests" versus "mate choice" modes of sexual selection. *Archives of Sexual Behavior*, 40, 551-557. doi:10.1007/s10508-010-9625-0

Hofferth, S.L., Reid, L., & Mott, F.L. (2001). The effects of early childbearing on schooling over time. *Family Planning Perspectives*, 33, 259-267. doi:10.2307/3030193

Holekamp, K.E., Smale, L., & Szykman, M. (1996). Rank and reproduction in the female spotted hyaena. *Journal of Reproduction and Fertility*, 108, 229–237. doi:10.1530/jrf.0.1080229

Holland, J.H. (1992). Complex adaptive systems. *Daedalus*, 121, 17-30.

Hooper, C.J., Luviana, M., Conklin, H.M., & Yarger, R.S. (2004). Adolescents' performance on the Iowa Gambling Task: Implications for the development of decision making and ventromedial prefrontal cortex. *Developmental Psychology*, 40, 1148–1158. doi:10.1037/0012-1649.40.6.1148

Horgan, T.G., Mast, M.S., Hall, J.A., & Carter, J.D. (2004). Gender differences in memory for the appearance of others. *Personality and Social Psychology Bulletin*, 30, 185-196. doi:10.1177/0146167203259928

Horvath, P., and Zuckerman, M. (1993). Sensation seeking, risk appraisal and risky behavior. *Personality and Individual Differences*, 14, 41-52. doi:10.1016/0191-8869(93)90173-Z

Hrdy, S.B. (1981). *The Woman That Never Evolved*. Harvard University Press.

Hsu, C., Soong, W., Stigler, J.W., Hong, C. & Liang, C. (1981). The temperamental characteristics of Chinese babies. *Child Development*, 52, 1337-1340. doi:10.2307/1129528

Hu, L-T. and Bentler, P.M. (1999). Cutoff criteria for fitness indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modelling: A Multidisciplinary Journal*, 6, 1-55. doi:10.1080/10705519909540118

Huff-Corzine, L., Corzine, J., & Moore, D.C. (1991). Deadly connections: culture, poverty and the direction of lethal violence. *Social Forces*, 69, 715-732. doi:10.2307/2579472

Hull, M.G., Fleming, C.F., Hughes, A.O., & McDermott, A. (1996). The age-related decline in female fecundity: a quantitative controlled study of implanting capacity and survival of individual embryos after in vitro fertilization. *Fertility and Sterility*, 65, 783-790.

*Hulsey, C.D. (2001). Predictors of problem gambling among college students. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 61, (7-B),* 3847.

*Hunt, M.K., Hopko, D.R., Bare, R., Lejuez, C.W., & Robinson E.V. (2005). Construct validity of the Balloon Analog Risk Task (BART): Associations with psychopathy and impulsivity. *Assessment*, 12, 416-428. doi:10.1177/1073191105278740

Hurtado, A. M., & Hill, K. R. (1990). Seasonality in a foraging society: Variation in diet, work effort, fertility and the sexual division of labor among the Hiwi of Venezuela. *Journal of Anthropological Research*, 46, 293–345.

*Hutchinson, G.T., Patock-Peckham, J.A., Cheong, J., & Nagoshi, C.T. (1998). Irrational beliefs and behavioral misregulation in the role of alcohol abuse among college students. *Journal of Rational-Emotive and Cognitive Behavior Therapy, 16*, 61-74. doi: 10.1023/A:1024950407778

Hyde, J.S. (1986). Gender differences in aggression. In Hyde, J.S. & Linn, M.C. (Eds.) *The Psychology of Gender: Advances Through Meta-Analysis* (pp. 51-66). Baltimore, MD: Johns Hopkins University Press.

*Jack, S.J., & Ronan, K.R. (1998). Sensation seeking among high- and low-risk sports participants. *Personality and Individual Differences, 25,* 1063-1083. doi:10.1016/S0191-8869(98)00081-6

*Jackson, C.P., & Matthews, G. (1988). The prediction of habitual alcohol use from alcohol related expectancies and personality. *Alcohol and Alcoholism, 23,* 305-314.

Jackson, D. N. (1994). *Jackson Personality Inventory—Revised manual*. Research Psychologists Press, Port Huron, MI.

Jackson, J. J., & Ellis, B. J. (2009). Synthesizing life history theory with sexual selection: Toward a comprehensive model of alternative reproductive strategies. *Behavioral and Brain Sciences*, 32, 31–32. doi:10.1017/S0140525X09000132

Jackson, J.J., & Kirkpatrick, L.A. (2007). The structure and measurement of human mating strategies: toward a multidimensional model of sociosexuality. *Evolution and Human Behavior*, 28, 382-391. doi:10.1016/j.evolhumbehav.2007.04.005

James, J., Ellis, B.J. Schlomer, G.L. & Garber, J. (2012). Sex specific pathways to early puberty, sexual debut and sexual risk taking: test of an integrated evolutionary-developmental model. *Developmental Psychology*, 48, 687-702. doi:10.1037/a0026427

*January, E.W. (2003). Young adult offspring of divorced/separated parents: An investigation of their needs for control, structure, and order. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 64, (3-B),* 1494.

Jennions, M.D. & Petrie, M. (2000). Why do females mate multiply? A review of the genetic benefits. *Biological Review*, 75, 21-64. doi:10.1017/S0006323199005423

Jensen, A. R. (1998). *The g Factor: The Science of Mental Ability.* Westport, CT: Praeger Publishers.

Johns, S.E. (2011). Perceived environmental risk as a predictor of teenage motherhood in a British population. *Health & Place*, 122-131. doi:10.1016/j.healthplace.2010.09.006

*Johnson, M.W., Bickel, W.K., & Baker, F. (2007). Moderate drug use and delay discounting: A comparison of heavy, light, and never smokers. *Experimental and Clinical Psychopharmacology*, 15, 187-194. doi:10.1037/1064-1297.15.2.187

Jokela, M., Rotkirch, A., Rickard, I.J., Pettay, J., & Lummaa, V. (2010). Serial monogamy increases reproductive success in men but not in women. *Behavioral Ecology*, 21, 906-912. doi:10.1093/beheco/arq078

*Jollant, F., Bellivier, F., Leboyer, M., Astruc, B., Torres, S., Verdier, R., et al. (2005). Impaired decision making in suicide attempters. *American Journal of Psychiatry*, 162, 304-310. doi:10.1176/appi.ajp.162.2.304

Jonason, P. K., Li, N. P., Webster, G. W., & Schmitt, D. P. (2009). The Dark Triad: Facilitating short-term mating in men. *European Journal of Personality*, 23, 5–18. doi:10.1002/per.698

Jonason, P.K., Koenig, B.L. & Tost, J. (2010). Living a fast life: the dark triad and life history theory. *Human Nature*, 21, 428-442. doi:10.1007/s12110-010-9102-4.

*Justus, A.N., Finn, P.R., & Steinmetz, J.E. (2001). P300, disinhibited personality, and early-onset alcohol problems. Alcoholism: Clinical and Experimental Research, 25, 1457-1466. doi:10.1111/j.1530-0277.2001.tb02147.x

Kagan, J., Rosman, B. L., Day, D., Albert, J., & Phillips, W. (1964). Information-processing in the child: Significance of analytic and reflective attitudes. *Psychological Monographs*, 78, 1-37. doi:10.1037/h0093830

Kahn, J. A., Kaplowitz, R. A., Goodman, E., & Emans, S. J. (2002). The association between impulsiveness and sexual risk behaviors in adolescent and young adult women. *Journal of Adolescent Health*, 30, 229-232. doi:10.1016/S1054-139X(01)00391-3

Kanazawa, S. (2003). Can evolutionary psychology explain reproductive behaviour in the contemporary United States? *Sociological Quarterly*, 44, 291-302. doi:10.1111/j.1533-8525.2003.tb00559.x

Kaplan, H.S. & Gangestad, S.W. (2005). Life history theory and evolutionary psychology. In Buss, D.M. (Ed.), *Handbook of Evolutionary Psychology* (pp. 68 - 95). Hoboken, NJ: Wiley.

Kaprio, J., Rimpela, A., Winter, T., Viken, R.J., Rimplela, M., & Rose, R.J. (1995). Common genetic influences on BMI and age at menarche. *Human Biology*, 67, 739-753.

*Kazemi, D.M. (2007). Problematic drinking among college students: The role of impulsivity and resistance to change. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 68,* (3-B), 1591.

Keane, C., Maxim, P., & Teevan, J. (1993). Drinking and driving, self-control, and gender. *Journal of Research in Crime and Delinquency*, 30, 30– 46. doi:10.1177/0022427893030001003

*Keilp, J.G., Sackeim, H.A., & Mann, J.J. (2005). Correlates of trait impulsiveness in performance measures and neuropsychological tests. *Psychiatry Research*, 135, 191-201. doi:10.1016/j.psychres.2005.03.006

Kessler, R.C., Coccaro, E.F., Fava, M., Jaeger, S., Jin, R., & Walters, E. (2006). The prevalence and correlates of DSM-IV intermittent explosive disorder in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 63, 669-678. doi:10.1001/archpsyc.63.6.669

*Ketzenberger, K.E., & Forrest, L. (2000). Impulsiveness and compulsiveness in alcoholics and nonalcoholics. *Addictive Behaviors*, 25, 791-795. doi:10.1016/S0306-4603(00)00062-9

Khurana, A., Romer, D., Betancourt, L.M., Brodsky, N.L., Giannetta, J.M. & Hurt, H. (2012). Early adolescent sexual debut: the mediating role of working memory ability, sensation seeking and impulsivity. *Developmental Psychology*, 48, 1416-1428. doi:10.1037/a0027491

Kim, K., Smith, P.K., & Palermiti, A.L. (1997). Conflict in childhood and reproductive development. *Evolution and Human Behavior*, 18, 109-142. doi:10.1016/S1090-5138(96)00114-6

Kindlon, D., Mezzacappa, E., & Earls, F. (1995). Psychometric properties of impulsivity measures: Temporal stability, validity and factor structure. *Journal of Child Psychology and Psychiatry and Allied Discipline*, 36, 645-661. doi:10.1111/j.1469-7610.1995.tb01316.x

King, J.E., Weiss, A., & Sisco,M.M. (2008). Aping humans: Age and sex effects in chimpanzees (Pan troglodytes) and human (Homo sapiens) personality. *Journal of Comparative Psychology*, 122, 418-427. doi:10.1037/a0013125

Kirby, D., Coyle, K., & Gould, J.B. (2001). Manifestations of poverty and birth rates among young teenagers in California zip code areas. *Family Planning Perspectives*, 33, 63-69. doi:10.2307/2673751

*Kirby, K.N., & Petry, N.M. (2004). Heroin and cocaine abusers have higher discount rates for delayed rewards than alcoholics or non-drug-using controls. *Addiction*, 99, 461-471. doi:10.1111/j.1360-0443.2003.00669.x

*Kirby, K.N., Godoy, R., Reyes-Garcia, V., Byron, E., Apaza, L., Leonard, W., et al. (2002). Correlates of delay-discount rates: Evidence from Tsimane' Amerindians of the Bolivian rain forest. *Journal of Economic Psychology*, 23, 291-316. doi:10.1016/S0167-4870(02)00078-8

Kirby, K.N., Petry, N.M., & Bickel, W.K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology General*, 128, 78-87. doi:10.1037/0096-3445.128.1.78

*Kirby, K.N., Winston, G.C., & Santiesteban, M. (2005). Impatience and grades: Delay-discount rates correlate negatively with college GPA. *Learning and Individual Differences*, 15, 213-222. doi:10.1016/j.lindif.2005.01.003

Kirk, K.M., Blomberg, S.P., Duffy, D.L., Heath, A.C., Owens, I.P.F., & Martin, N.G. (2001). Natural selection and quantitative genetics of life history traits in western women: A twin study. *Evolution*, 55, 423-435. doi:10.1554/0014-3820(2001)055%5B0423:NSAQGO%5D2.0.CO;2

*Kirkcaldy, B.D., Eysenck, M., Furnham, A.F., & Siefen, G. (1998). Gender, anxiety and self-image. *Personality and Individual Differences*, 24, 677-684. doi:10.1016/S0191-8869(97)00226-2

Kline, M.A., Boyd, R., & Henrich, J. (2013). Teaching and the Life History of Cultural Transmission in Fijian Villages. *Human Nature*, 24, 351-374. doi:10.1007/s12110-013-9180-1

Kline, R.B. (2005). *Principles and Practice of Structural Equation Modelling (2nd Ed).* New York: Guildford Press.

*Klinteberg, B.A., Schalling, D., Edman, G., Oreland, L., & Asberry, M. (1987). Personality correlates of platelet Monoamine Oxidase (MAO) activity in female and male subjects. *Neuropsychobiology*, 18, 89-96. doi:10.1159/000118399

Knight, G.P., Fabes, R.A., & Higgins, D.A. (1996). Concerns about drawing causal inferences from meta-analyses: An example in the study of gender differences in aggression. *Psychological Bulletin*, 119, 410-421. doi:10.1037/0033-2909.119.3.410

Knight, G.P., Guthrie, I.K., Page, M.C., & Fabes, R.A. (2002). Emotional arousal and gender differences in aggression: A meta-analysis. *Aggressive Behavior*, 28, 366-393. doi:10.1002/ab.80011

Kochanska, G., & Knaack, A. (2003). Effortful control as a personality characteristic of young children: Antecedents, correlates, and consequences. *Journal of Personality*, 71, 1087-1112. doi:10.1111/1467-6494.7106008

Kokko, H. & Jennions, M.D. (2008). Parental investment, sexual selection and sex ratios. *Journal of Evolutionary Biology*, 21, 919-948. doi:10.1111/j.1420-9101.2008.01540.x

*Kollins, S.H. (2003). Delay discounting is associated with substance use in college students. *Addictive Behaviors*, 28, 1167-1173. doi:10.1016/S0306-4603(02)00220-4

Koopmans, J.R., Boomsa, D.I., Heath, A.C., & van Doornen, L.J.P. (1995). A multivariate genetic analysis of sensation seeking. *Behavior Genetics*, 25, 349-356. doi:10.1007/BF02197284

Kozinszky, Z., & Bártai, G. (2004). Contraceptive behaviour of teenagers requesting abortion. *European Journal of Obstetrics, Gynaecology and Reproductive Biology*, 15, 80-83. doi:10.1016/S0301-2115(03)00277-X

Kposowa, A.J., Breault, K.D., & Harrison, B.M. (1995). Reassessing the structural covariates of violent and property crimes in the USA: A county level analysis. *The British Journal of Sociology*, 46, 79-105. doi:10.2307/591624

Kraaijeveld, K., Kraaijeveld-Smit, F. J. L. & Komdeur, J. (2007). The evolution of mutual ornamentation. *Animal Behaviour*, 74, 657–677. doi:10.1016/j.anbehav.2006.12.027

Kronester-Frei, A. (1975). Light and electron microscopical studies of the brood epithelium of the male Nerophis lumbriciformes (Pennant 1976), Syngnathidae, with special reference to the structural changes in the egg membrane (zona radiata). *Forma et Functio*, 8, 419-462.

*Krueger, R.F., Markon, K.E., Patrick, C.J., Benning, S.D., & Kramer, M.D. (2007). Linking antisocial behaviour, substance use, and personality: An integrative quantitative model of the adult externalizing spectrum. *Journal of Abnormal Psychology*, 116, 645-666. doi:10.1037/0021-843X.116.4.645

Kruger, D. J., & Nesse, R. M. (2006). An evolutionary life-history framework for understanding sex differences in human mortality rates. *Human Nature*, 17, 74-97. doi:10.1007/s12110-006-1021-z

Kruger, D.J., Reischl, T., Zimmerman, M.A. (2008). Time perspective as a mechanism for functional development adaptation. *Journal of Social, Evolutionary and Cultural Psychology*, 2, 1-22. doi:10.1037/h0099336

La Boeuf, B.J. & Peterson, R.S. (1969). Social status and mating activity in elephant seals. *Science*, 163, 91-93. doi:10.1126/science.166.3913.1654

La Boeuf, B.J. & Reiter, J. (1988). Lifetime reproductive success in northern elephant seals. In Clutton-Brock, T.H. (Ed.). *Reproductive Success: Studies of Individual Variation in Contrasting Breeding Systems* (pp.344-362). Chicago: University of Chicago press.

Laflin, M. T., Wang, J., & Barry, M. (2008). A longitudinal study of adolescent transition from virgin to nonvirgin status. *Journal of Adolescent Health*, 42, 228–236. doi:10.1016/j.jadohealth.2007.08.014.

LaGrange, T. C., & Silverman, R. A. (1999). Low self-control and opportunity: Testing the general theory of crime as an explanation for gender differences in delinquency. *Criminology*, 37, 41– 72. doi:10.1111/j.1745-9125.1999.tb00479.x

Laland, K.N. (2007). Niche construction, human behavioural ecology and evolutionary psychology. In Dunbar, R.I.M., & Barrett, L. (Eds*). The Oxford Handbook of Evolutionary Psychology*. Oxford: Oxford University Press.

Lalumière, M.L. & Quinsey, V.L. (1996). Sexual deviance, antisociality, mating effort, and the use of sexually coercive behaviours. Personality and Individual Differences, 21, 33-48. doi:10.1016/0191-8869(96)00059-1

Lanctot, N., & Smith, C. A. (2001). Sexual activity, pregnancy, and deviance in a representative urban sample of African American girls. *Journal of Youth and Adolescence*, 30, 349–372. doi:10.1023/A:1010496229445.

Land, H.C., McCall, P.L., & Cohen, L.E. (1990). Structural covariates of homicide rates: are there any invariances across time and social space. *The American Journal of Sociology*, 95, 922-963. doi:10.1086/229381

Lane, S.D., Cherek, D.R., Rhodes, H.M., Pietras, C.J., & Tcheremissine, O.V. (2003). Relationships among laboratory and psychometric measures of impulsivity: Implications in substance abuse and dependence. *Addictive Disorders and Their Treatment*, 2, 33-40. doi:10.1097/00132576-200302020-00001

Larsen, C.S. (2003). Equality for the sexes in human evolution? Early hominid sexual dimorphism and implications for mating systems and social behaviour. *Proceedings of the National Academy of Sciences of the United States of America*, 100, 9103-9104. doi:10.1073/pnas.1633678100

Laumann, E. O., Gagnon, J. H., Michael, R. T., & Michaels, S. (1994). *The social organization of sexuality: Sexual practices in the United States. Chicago: University of Chicago Press.*

LeBas, N. R. (2006). Female finery is not for males. *Trends in Ecology & Evolution*, 21, 170–173. doi:10.1016/j.tree.2006.01.007

Lee, R.B. (1979). *The Kung-San: Men Women and Work in a Foraging Society*. Cambridge University Press.

Leenaars, L.S., Dane, A.V. & Marini, Z.A. (2008). Evolutionary perspectives on indirect victimization in adolescence: the role of attractiveness, dating and sexual behaviour. *Aggressive Behavior*, 34, 404-415. doi:10.1002/ab.20252

*Lehnart, K.L., Overhober, J.C., & Spiritio, A. (1994). Internalized and externalized anger in adolescent suicide attempters. *Journal of Adolescent Research*, 9, 105-119. doi:10.1177/074355489491008

Lehre, A.C., Lehre, K.P., Laake, P., & Danbolt, N.C. (2009). Greater intrasex phenotype variability in males than in females is a fundamental aspect of gender differences in humans. *Developmental Psychobiology*, 51, 198-206. doi:10.1002/dev.20358

*Lejuez, C. W., Aklin, W.M., Jones, H.A., Richards, J.B., Strong, D.R., Kahler, C.W. et al. (2003). The balloon analogue risk task (BART) differentiates smokers and nonsmokers. *Experimental and Clinical Psychopharmacology*, 11, 26-33. doi:10.1037/1064-1297.11.1.26

*Lejuez, C. W., Read, J.P., Kahler, C.W., Richards, J.B., Ramsey, S.E., Stuart, G.L., et al. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task. *Journal of Experimental Psychology: Applied*, 8, 75-84. doi:10.1037/1076-898X.8.2.75

Lemaire, J. (2002). Why do females live longer than males? *North American Actuarial Journal*, 6, 21-37. doi:10.1080/10920277.2002.10596061

Lengua, L. (2002). The contribution of emotionality and self-regulation to the understanding of children's response to multiple risk. *Child Development*, 72, 144-161. doi:10.1111/1467-8624.00397

*Lennings, C.J. (1991). The Schalling Sensation Seeking and Impulsivity Scales: Their relationship to time perspective and time awareness. A preliminary report. *Psychological Reports*, 69, 131-136. doi:10.2466/PR0.69.5.131-136

*Lennings, C.J., & Burns, A.M. (1998). Time perspective: Temporal extension, time estimation, and impulsivity. *Journal of Psychology: Interdisciplinary and Applied*, 132, 367-380. doi:10.1080/00223989809599271

Leppalahti, S., Gissler, M., Mentula, M., & Heikinheimo, O. (2013). Is teenage pregnancy an obstetric risk in a welfare society? A population-based study in Finland, from 2006 to 2011. *BMJ Open*, 1-10, doi:10.1136/bmjopen-2013-003225

Lerner, J. S., & Keltner, D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & Emotion, 14*, 473-493. doi:10.1080/026999300402763

*Leshem, R., & Glicksohn, J. (2007). The construct of impulsivity revisited. *Personality and Individual Differences*, 43, 681-691. doi:10.1016/j.paid.2007.01.015

Lewin, A.C. (2005). The effect of economic stability on family stability among welfare recipients. *Evaluation Review*, 29, 223-240. doi:10.1177/0193841X04272558

*Li, C-S.R., & Chen, S-H. (2007). Obsessive-compulsiveness and impulsivity in a non-clinical population of adolescent males and females. *Psychiatry Research*, 149, 129-138. doi:10.1016/j.psychres.2006.05.001

*Li, C-S.R., Huang, C-Y., & Sun, C-W.V. (2007). Gender differences in punishment and reward sensitivity in a sample of Taiwanese college students. *Personality and Individual Differences*, 43, 475-483. doi:10.1016/j.paid.2006.12.016

Lichter, D.T., Qian, Z., & Mellott, L.M. (2006). Marriage or dissolution? Union transitions among poor cohabiting women. *Demography*, 43, 223-240. doi:10.1353/dem.2006.0016

*Lijffijt, M., Caci, H., & Kenemans, J.L. (2005). Validation of the Dutch translation of the I7 questionnaire. *Personality and Individual Differences*, 38, 1123-1133. doi:10.1016/j.paid.2004.07.010

Limbos, M. A., & Casteel, C. (2008). Schools and neighborhoods: organizational and environmental factors associated with crime in secondary schools. *Journal of School Health*, 78, 539–544. doi:10.1111/j.1746-1561.2008.00341.x

Lipsey, M.W., & Wilson, D.B. (2001). *Practical Meta Analysis*. London: Sage Publications Ltd.

Liran, D., Vardi, I.S., Sergienko, R. & Sheiner, E. (2013). Adverse perinatal outcome in teenage pregnancies: is it all due to lack of prenatal care and ethnicity? *Journal of Maternal-Fetal & Neonatal Medicine*, 26, 469-472. doi**:**10.3109/14767058.2012.738262

Little, T.D., Jones, S.M., Henrich, C.C., & Hawley, P.H. (2003). Disentangling the "whys" from the "whats" of aggressive behaviour. *International Journal of Behavioral Development*, 27, 122-133. doi:10.1080/01650250244000128.

Llewellyn, D.J. (2008). The psychology of risk taking: Toward the integration of psychometric and neuropsychological paradigms. *American Journal of Psychology*, 121, 363-376. doi:10.2307/20445472

*Llorenet, M., & Torrubia, R. (1988). Type A behaviour patterns and personality variables: The correlations of impulsivity and anxiety as compared to extraversion and neuroticism. *European Journal of Psychiatry*, 2, 38-45.

Loehlin, J. C. (2004). *Latent Variable Models: An Introduction to Factor, Path and Structural Equation Analysis*. Mahwah: Lawrence Erlbaum Associates.

Loewenstein, G.F., Weber, R., Flory, J., Manuck, S., & Muldoon, M. (2001). Dimensions of time discounting. In *Presented at Conference on Survey Research on Household. Expectations and Preferences, Ann Arbor*, Nov. 2–3, 2001.

Loewenstein, G.F., Weber, E.U., Hsee, C.K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127, 267-286. doi:10.1037/0033-2909.127.2.267

Logan, G. D., Schachar, R. J., & Tannock, R. (1997). Impulsivity and inhibitory control. *Psychological Science*, 8, 60-64. doi:10.1111/j.1467-9280.1997.tb00545.x

Lohman, B.J. & Billings, A. (2008). Protective and risk factors associated with adolescent boys' early sexual debut and risky sexual behaviors. *Journal of Youth Adolescence*, 37, 723-735. doi:10.1007/s10964-008-9283-x

*Lonczak, H.S., Neighbors, C., & Donovan, D.M. (2007). Predicting risky and angry driving as a function of gender. *Accident Analysis and Prevention*, 39, 536–545. doi:10.1016/j.aap.2006.09.010

Longshore, D., Turner, S., & Stein, J. A. (1996). Self-control in a criminal sample: An examination of validity. *Criminology*, 34, 209– 228. doi:10.1111/j.1745-9125.1996.tb01203.x

*Lopez Viets, V.C. (2001). Psychosocial variables and college student gambling. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 61,* (7-B), 3850.

Lorber, M.F. (2004). Psychophysiology of Aggression, Psychopathy, and Conduct Problems: A Meta-Analysis. *Psychological Bulletin*, 130, 531–552. doi:10.1037/0033-2909.130.4.531

Low, B. S., Hazel, A., Parker, N., & Welch, K. B. (2008). Influences on women's reproductive lives: Unexpected ecological underpinnings. *Cross-Cultural Research*, 42, 201–219. doi:10.1177/1069397108317669

Lowe, J. R., Edmundson, M., & Widiger, T. A. (2009). Assessment of dependency, agreeableness, and their relationship. *Psychological Assessment*, 21, 543–553. doi:10.1037/a0016899

Luckinbill, L.S. (1979). Selection of the r/K continuum in experimental populations of protozoa. *American Naturalist*, 113, 427-437. doi:10.1086%2F283400

*Luengo, M.A., Carrillo-de-la-Pena, M.T., & Otero, J.M. (1990). The components of impulsiveness: A comparison of the I7 Impulsiveness Questionnaire and the Barratt Impulsiveness Scale. *Personality and Individual Differences*, 12, 657-667. doi:10.1016/0191-8869(91)90220-6

Luengo, M.A., Carrillo-de-la-Pena, M.T., Otero, J.M., and Romero, E. (1994). A short-term longitudinal study of impulsivity and antisocial behaviour. *Journal of Personality and Social Psychology*, 66, 542-547. doi:10.1037/0022-3514.66.3.542

*Lundahl, L.H. (1995). Separation of the effects of family history of alcoholism, heavy drinking, and gender on personality functioning and sensitivity to alcohol in college students. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 56, (5-B), 2874.

*Lyke, J.A., & Spinella, M. (2004). Associations among aspects of impulsivity and eating factors in a nonclinical sample. *International Journal of Eating Disorders*, 36, 229-233. doi:10.1002/eat.20025

Lykken, D.T. (1957). A study of anxiety in the sociopathic personality. *Journal of Abnormal and Social Psychology,* 55, 6-10. doi:10.1037/h0047232

Lykken, D. T. (1995). *The Antisocial Personalities.* Mahwah, NJ: Erlbaum.

MacArthur R.H. & Wilson E. O. (1967) *The Theory of Island Biogeography*. Princeton University Press: Princeton, N.J.

MacDonald, K. B. (2008). Effortful control, explicit processing and the regulation of human evolved predispositions. *Psychological Bulletin*, 115, 1012–1031. doi:10.1037/a0013327.

Macleod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin*, 109, 163-203. doi:10.1037/0033-2909.109.2.163

*Macpherson, J., Sternhagen, S., Miller, T., Devitt, M., Petros, T.V., & Beckwith, B. (1996). Effect of caffeine, impulsivity and gender on the components of text processing and recall. *Experimental and Clinical Psychopharmacology*, 4, 438-446. doi:10.1037/1064-1297.4.4.438

Madden, G.J., Begotka, A.M., Raiff, B.R., & Kastern, L.L. (2003). Delay discounting of real and hypothetical rewards. *Experimental and Clinical Psychopharmacology*, 11, 139–145. doi:10.1037/1064-1297.11.2.139

*Magid, V., & Colder, C.R., (2007). The UPPS Impulsive Behavior Scale: Factor structure and associations with college drinking. *Personality and Individual Differences*, 43, 1927-1937. doi:10.1016/j.paid.2007.06.013

*Magid, V., MacLean, M.G., & Colder, C.R. (2007). Differentiating between sensation seeking and impulsivity through their mediated relations with alcohol use and problems. *Addictive Behaviors*, 32, 2046-2061. doi:10.1016/j.addbeh.2007.01.015

Main, M. & Goldwyn, R. (1998). Adult attachment scoring and classification system. *Unpublished manuscript*, University of California at Berkeley.

*Malle, B.F., & Neubauer, A.C. (1991). Impulsivity, reflection, and questionnaire response latencies: No evidence for a broad impulsivity trait. *Personality and Individual Differences*, 12, 865-871. doi:10.1016/0191-8869(91)90153-3

*Mallet, P., & Vignoli, E. (2007). Intensity seeking and novelty seeking: Their relationship to adolescent risk behaviour and occupational interests. *Personality and Individual Differences*, 43, 2011-2021. doi:10.1016/j.paid.2007.06.018

*Manuck, S.B., Flory, J.D., McCaffery, J.M., Matthews, K.A., Mann, J.J., & Muldoon, M.F. (1998). Aggression, impulsivity, and central nervous system serotonergic responsivity in a nonpatient sample. *Neuropsychopharmacology*, 19, 287-299. doi:10.1038/sj.npp.1395199

*Maras, P., Brosnan, M., Faulkner, N., Montgomery, T., & Vital, P. (2006). 'They are out of control': Self-perceptions, risk-taking and attributional style of adolescents with SEBDs. *Emotional & Behavioural Difficulties*, 11, 281-298. doi:10.1080/13632750601043861

*Marczinski, C.A., Combs, S.W., & Fillmore, M.T. (2007). Increased sensitivity to the disinhibiting effects of alcohol in binge drinkers. *Psychology of Addictive Behaviors*, 21, 346-354. doi:10.1037/0893-164X.21.3.346

Masi, C.M., Hawkley, L.C., Piotrowski, Z. H., & Pickett, K.E. (2007). Neighborhood economic disadvantage, violent crime, group density, and pregnancy outcomes in a diverse, urban population. *Social Sciences and Medicine*, 65, 2440-2457. doi:10.1016/j.socscimed.2007.07.014

*Matczak, A. (1990). Reflection-impulsivity: Need for stimulation and intellectual potentialities. *Polish Psychological Bulletin*, 21, 17-25.

Matthews, P. & Sear, R. (2008). Life after death: An investigation into how mortality perceptions influence fertility preferences using evidence from an internet-based experiment. *Journal of Evolutionary Psychology*, 6, 155-172. doi:10.1556/JEP.6.2008.3.1

*Maydeu-Olivares, A., Rodriguez-Fornells, A., Gomez-Benito, J., & D'Zurilla, T. J. (2000). Psychometric properties of the Spanish adaptation of the Social Problem-Solving Inventory-Revised (SPSI-R). *Personality and Individual Differences, 29,* 699-708. doi:10.1016/S0191-8869(99)00226-3

Maziade, M., Boudreault, M., Thiverge, J., Caperaa, P., & Cote, R. (1984). Infant temperament: SES and gender differences and reliability of measurement in a large Quebec sample. *Merrill-Palmer Quarterly Journal of Developmental Psychology, 30,* 213-226.

Mazur, J.E., 1987. An adjusting procedure for studying delayed reinforcement. In: Commons, M.L., Mazur, J.E., Nevin, J.A., Rachlin, H. (Eds.), *Quantitative Analysis of Behavior*. *Vol. 5. The Effect of Delay and of Intervening Events on Reinforcement Value*. Erlbaum, Hillsdale, NJ, pp. 55–73.

*McAlister, A.R., Pachana, N., & Jackson, C.J. (2005). Predictors of young dating adults' inclination to engage in extradyadic sexual activities: A multi-perspective study. *British Journal of Psychology*, 96, 331-350. doi:10.1348/000712605X47936

McClure, S.M., Laibson, D.I., Loewenstein, G. & Cohen, J.D. (2004). Separate neural systems value immediate and delayed monetary rewards. *Science*, 306, 503-507. doi:10.1126/science.1100907

*McCrae, R.R., & Costa, P.T. (1985). Comparison of EPI and psychoticism with measures of the five-factor model of personality. *Personality and Individual Differences*, 6, 587-597. doi:10.1016/0191-8869(85)90008-X

McCrae, R.R., Terracciano, A., & 78 Members of the Personality Profiles of Cultures Project (2005). Universal features of personality traits from the observer's perspective: Data from 50 cultures. *Journal of Personality and Social Psychology*, 88, 547–561. doi:10.1037/0022-3514.88.3.547

*McDaniel, S.R., & Zuckerman, M. (2003). The relationship of impulsive sensation seeking and gender to interest and participation in gambling activities. *Personality and Individual Differences*, 35, 1385-1400. doi:10.1016/S0191-8869(02)00357-4

Mcdonald, M.M., Donnellan, M.B. & Navarrete, C.D. (2012). A life history approach to understanding the dark triad. *Personality and Individual Differences, 52*, 601-605. doi:10.1016/j.paid.2011.12.003.

McElreath, R., Lubell, M., Richerson, P., et al. (2005). Applying evolutionary models to the laboratory study of social learning. *Evolution and Human Behavior*, 26, 483-508.

*McFatter, R.M. (1998). Emotional intensity: Some components and their relations to extraversion and neuroticism. *Personality and Individual Differences,* 24, 747-758. doi:10.1016/S0191-8869(97)00220-1

McLean, C. P., & Anderson, E. R. (2009). Brave men and timid women? A review of the gender differences in fear and anxiety. *Clinical Psychology Review*, 29, 496-505. doi:10.1016/j.cpr.2009.05.003

*McLeish, K.N., & Oxoby, R.J. (2007). Measuring impatience: Elicited discount rates and the Barratt Impulsiveness Scale. *Personality and Individual Differences*, 43, 553-565. doi:10.1016/j.paid.2007.01.002

*McMahon, S.D., & Washburn, J.J. (2003). Violence prevention: An evaluation of program effects with urban African American students. *Journal of Primary Prevention*, 24, 43-62. doi:10.1023/A:1025075617356

*Meadows, William Robert (1995). The role of individual difference variables in accounting for associations between alcohol consumption and sexual risk-taking. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 56, (12-B), 7050.

Meda, S.A., Stevens, M.C., Potenza, M.N., Pittman, B., Gueorguieva, R., Andrews, M.M., et al. (2009). Investigating the behavioral and self-report constructs of impulsivity domains using principal component analysis. *Behavioral Pharmacology*, 20, 390-399. doi:10.1097/FBP.0b013e32833113a3

*Mehrabian, A. (2000). Beyond IQ: Broad-based measurement of individual success potential or "emotional intelligence". *Genetic, Social, and General Psychology Monographs*, 126, 133-239.

*Mejia, R., Kliewer, W., & Williams, L. (2006). Domestic violence exposure in Columbian adolescents: Pathways to violent and prosocial behaviour. *Journal of Traumatic Stress*, 19, 257-267. doi:10.1002/jts.20116

Messick, S. (1989). Validity. In Linn, R.L. (ed.). *Educational measurement*. Third edition. New York: American Council on Education/Collier Macmillan, pp 13-103.

Messner, S.F., & Sampson, R.J. (1991). The sex ratio, family disruption, and rates of violent crime: the paradox of demographic structure. *Social Forces*, 69, 693-713. doi:10.2307/2579470

Meyer-Lindenberg, A., Buckholtz, J.W., Kolachana, B.R., Hariri, A., Pezawas, L., Wabnitz, A., et al. (2006). Neural mechanisms of genetic risk for impulsivity and violence in humans. *Proceedings of the National Academy of Sciences of the United States of America*, 103, 6269-6274. doi:10.1073/pnas.0511311103

Miettunen, J., Veijola, J., Lauronen, E., Kantojarvi, L., & Joukamaa, M. (2007). Sex differences in Cloninger's temperament dimensions: A meta-analysis. *Comprehensive Psychiatry*, 48, 161-169. doi:10.1016/j.comppsych.2006.10.007

Migliano, A.B., Vinicius, L., & Lahr, M.M. (2007). Life history trade-offs explain the evolution of human pygmies. *Proceedings of the National Academy of Sciences of the USA*, 104, 20216-9. doi:10.1073/pnas.0708024105

Milich, R., & Kramer, J. (1984). Reflections on impulsivity: An empirical investigation of impulsivity as a construct. In Gadow, K. and Bialer, I. (Eds). *Advances in Learning and Behavioral Disabilities* (Vol. 3, pp. 57-94). Greenwich, CT: JAI Press.

Miller, E., Joseph, S., & Tudway, J. (2004). Assessing the component structure of four self-report measures of impulsivity. *Personality and Individual Differences*, 37, 349-358. doi:10.1016/j.paid.2003.09.008

Mishra, S., & Lalumière, M.L. (2008). Risk taking, antisocial behavior and life histories. In Duntly, J.D. & Shackelford, T.K. (Eds.). *Evolutionary Forensic Psychology: Darwinian Foundations of Crime and Law* (pp. 139–159). New York: Oxford University Press.

Mishra, S., & Lalumière, M.L. (2011). Individual differences in risk-propensity: Associations between personality and behavioural measures of risk. *Personality and Individual Differences*, 50, 869-873. doi:10.1016/j.paid.2010.11.037

Mitchell, J.T., Kimbrel, N.A., Hundt, N.E., Cobb, A.R., Nelson-Gray, R.O., & Lootens, C.M. (2007). An analysis of Reinforcement Sensitivity Theory and the Five-Factor model. *European Journal of Personality*, 21, 869–887. doi:10.1002/per.644

Mitchell, S.H. (1999). Measures of impulsivity in cigarette smokers and non-smokers. *Psychopharmacology*, 146, 455-464. doi:10.1007/PL00005491

Mobini, S., Grant, A., Kass, A.E., & Yeomans, M.R. (2007). Relationships between functional and dysfunctional impulsivity, delay discounting and cognitive distortions. *Personality and Individual Differences*, 43, 1517-1528. doi:10.1016/j.paid.2007.04.009

Moch, A. (1996). Perceived density: how apartment dwellers view their surroundings. *European Journal of Geography*, 82, 131-132.

Moffitt, T. E., Caspi, A. Belsky, J. & Silva, P. A. (1992). Childhood experience and onset of menarche: A test of a sociobiological model. Child Development, 63, 47–58. doi:10.1111/j.1467-8624.1992.tb03594.x

Moffitt, T.E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Review*, 4, 674-701. doi:10.1037//0033-295X.100.4.674

Moffitt, T., Caspi, A., Belsky, J., & Silva, P.A. (1992). Childhood experience and the onset of menarche. *Child Development*, 63, 47-58. doi:10.2307/1130900

Moffitt, T., Caspi, A., Rutter, M., & Silva, P.A. (2001). *Sex Differences in Antisocial Behaviour: Conduct Disorder, Delinquency and Violence in the Dunedin Longitudinal Study*. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511490057

Mogg, K., Bradley, B. P., Dixon, C., Fisher, S., Twelftree, H., & McWilliams, A. (2000). Trait anxiety, defensiveness and selective processing of threat: An investigation using two measures of attentional bias. *Personality and Individual Differences*, 28, 1063−1077. doi:10.1016/S0191-8869(99)00157-9

*Molto, J., Segarra, P., & Avila, C. (1993). Impulsivity and total response speed to a personality questionnaire. *Personality and Individual Differences*, 15, 97-98. doi:10.1016/0191-8869(93)90047-7

Munafo, M.R., Yalcin, B., Willis-Owne, S.A., & Flint, J. (2008). Association of the Dopamine D4 receptor (DRD4) gene and approach related personality traits: Meta-analysis and new data. *Biological Psychiatry*, 63, 197-206. doi:10.1016/j.biopsych.2007.04.006

Muncer, S. (2013). The general factor of personality: evaluating the evidence from meta-analysis, confirmatory factor analysis and evolutionary theory. *Personality and Individual Differences*, 51, 775-778. doi:10.1016/j.paid.2011.06.029

Muraven, M., & Baumeister, R.F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*, 126, 247-259. doi:10.1037/0033-2909.126.2.247

Murray, K. T., & Kochanska, G. (2002). Effortful control: Factor structure and relation to externalizing and internalizing behaviors. *Journal of Abnormal Child Psychology*, 30, 503-514. doi:10.1023/A:1019821031523

Nagin, D.S. & Pogarsky, G. (2004). Time and punishment: delayed consequences and criminal behavior. *Journal of Quantitative Criminology*, 20, 295-317. doi:10.1007/s10940-004-5866-1

*Nagoshi, C.T. (1999). Perceived control of drinking and other predictors of alcohol use and problems in a college student sample. *Addiction Research*, 7, 291-306. doi:10.3109/16066359909004388

*Nagoshi, C.T., Wood, M.D., Cote, C.C., & Abbit, S.M. (1994). College drinking game participation within the context of other predictors of alcohol use and problems. *Psychology of Addictive Behaviors*, 8, 203-213. doi:10.1037/0893-164X.8.4.203

Najman, J.M., Hayatbakhsh, M.R., McGee, T, Bor, W, O'Callaghan, M., & Williams, G.M. (2009) The impact of puberty on aggression/delinquency: Adolescence to young adulthood. *The Australian and New Zealand Journal of Criminology*, 42, 369-386. doi:10.1375/acri.42.3.369

Nakhaie, M. R., Silverman, R. A., & LaGrange, T. C. (2000). Self-control and social control: An examination of gender, ethnicity, class, and delinquency. *Canadian Journal of Criminology*, 25, 35-59. doi:10.2307/3341910

National Readership Survey (January 2011). http://www.nrs.co.uk/lifestyle-data/

*Neal, D.J., & Carey, K.B. (2007). Association between alcohol intoxication and alcohol-related problems: An event-level analysis. *Psychology of Addictive Behaviors*, 21, 194-204. doi:10.1037/0893-164X.21.2.194

Nederhof, E. & Schmidt, M.V. (2012). Mismatch or cumulative stress: Toward an integrated hypothesis of programming effects. *Physiology and Behavior*, 106, 691-700. doi:10.1016/j.physbeh.2011.12.008

Negriff, S., Susman, E.J. and Trickett, P.K. (2011).The developmental pathway from pubertal timing to delinquency and sexual activity from early to late adolescence. *Journal of Youth and Adolescence*, 40, 1343-1356. doi:10.1007/s10964-010-9621-7.

Nettle, D. (2006). The evolution of personality variation in humans and other animals. *American Psychologist*, 61, 622-631. doi:10.1037/0003-066x.61.6.622

Nettle, D. (2010). Dying young and living fast: Variation in life history across English neighborhoods. *Behavioral Ecology*, 21, 387–395. doi:10.1093/beheco/arp202

Nettle, D. (2011). Flexibility in reproductive timing in human females: integrating ultimate and proximate explanations. *Proceedings of the Royal Society B: Biological Sciences,* 366, 357-365. doi:10.1098/rstb.2010.0073

Nettle, D., Coall, D.A., Dickins, T.E. (2010). Birthweight and paternal involvement predict early reproduction in British women: evidence from the National Child Development Study. *American Journal of Human Biology*, 22, 172–179. doi:10.1002/ajhb.20970

Nettle, D., Coall, D.A., Dickins, T.E. (2011). Early-life conditions and age at first pregnancy in British women. *Proceedings of the Royal Society B: Biological Sciences,* 278, 1721–1727. doi:10.1098/rspb.2010.1726

Nettle, D., Coyne, R., & Colléony, A. (2012). No country for old men: street use and social diet in urban Newcastle. *Human Nature*, 23, 375–385. doi:10.1007/s12110-012-9153-9

Nettle, D., Frankenhuis, W. E., & Rickard, I. J. (2013). The evolution of predictive adaptive responses in human life history. *Proceedings of the Royal Society B: Biological Sciences*, 280. doi:10.1098/rspb.2013.1343

Nettle, D., Gibson, M.A., Lawson, D.W. and Sear, R. (2013). Human behavioral ecology: current research an future prospects. *Behavioral Ecology*, 24, 1031-1040. doi:10.1093/beheco/ars222.

*Neubauer, A.C. (1992). Psychometric comparison of two circadian rhythm questionnaires and their relationship with personality. *Personality and Individual Differences*, 13,125-131. doi:10.1016/0191-8869(92)90035-N

Newman, J. P., Widom, C. S., & Nathan, S. (1985). Passive-avoidance in syndromes of disinhibition: Psychopathy and extraversion. *Journal of Personality and Social Psychology*, 48, 1316-1327. doi:10.1037/0022-3514.48.5.1316

Newman, J.P., MacCoon, D.G., Vaughn, L.J. & Sadeh, N. (2005). Validating a distinction between primary and secondary psychopathy with measures of Gray's BIS and BAS constructs. *Journal of Abnormal Psychology*, 114, 319-323. doi:10.1037/0021-843X.114.2.319

*Ng, H.S., Cooper, M., & Chandler, P. (1998).The Eysenckian personality structure: A "Giant Three" or "Big Five" model in Hong Kong? *Personality and Individual Differences*, 25, 1111-1131. doi:10.1016/S0191-8869(98)00106-8

Nicotera, N. (2007). Measuring neighborhood: A conundrum for human services researchers and practitioners. *American Journal of Community Psychology* 40, 26–51. doi:10.1007/s10464-007-9124-1

*Nietfeld, J., & Bosma, A. (2003). Examining the self-regulation of impulsive and reflective response styles on academic tasks. *Journal of Research in Personality*, 37, 118-140. doi:10.1016/S0092-6566(02)00564-0

Nigg, J. T. (2001). Is ADHD a disinhibitory disorder? *Psychological Bulletin,* 127, 571-598. doi:10.1037//0033-2909.127.5.571

*Nijs, I.M.T., Franken, I.H.A., & Smulders, F.T.Y. (2007). BIS/BAS sensitivity and P300 event-related brain potential. *Journal of Psychophysiology*, 21, 83-90. doi:10.1027/0269-8803.21.2.83

Norris, F. H., Matthews, B. A., & Riad, J. K. (2000). Characterological, situational, and behavioral risk factors for motor vehicle accidents: A prospective examination. *Accident Analysis and Prevention*, 32, 505-515 doi:10.1016/S0001-4575(99)00068-8

*Nower, L., Derevensky, J.L., & Gupta, R. (2004). The relationship of impulsivity, sensation seeking, coping, and substance use in youth gamblers. *Psychology of Addictive Behaviors*, 18, 49-55. doi:10.1037/0893-164X.18.1.49

Nurmi, J. (1987). Age, sex, social class and quality of family interaction as determinants of adolescents' future orientation: a developmental task interpretation. *Adolescence*, 22, 977-991.

Nurmi, J. (1992). Age differences in adult life goals, concerns and their temporal extension: a life course approach to future oriented motivation. *International Journal of Behavioral Development*, 15, 487-508. doi: 10.1177/016502549201500404

*Oas, P. (1984). Validity of the Draw-a-Person and Bender Gestalt Tests as measures of impulsivity with adolescents. *Journal of Consulting and Clinical Psychology*, 52, 1011-1019. doi:10.1037/0022-006X.52.6.1011

Oberle, E., Schonert-Reichl, K.A., & Zumbo, B.D. (2011). Life satisfaction in early adolescence: personal, neighborhood, school, family and peer influences. *Journal of Youth and Adolescence*, 40, 889-901. doi:10.1007s!¬0964-010-9599-1

Oberwittler, D. (2007). The effects of neighbourhood poverty on adolescent problem behaviours: A multi-level analysis differentiated by gender and ethnicity. *Housing Studies*, 22, 781-803. doi:10.1080/02673030701474727

Odling-Smee, F.J., Laland, K.N., & Feldman, M.W. (2003). *Niche Construction: The Neglected process in Evolution. Monographs in Population Biology, Number 37*. Princeton: Princeton University press.

Offer, D., Ostrov, E., and Howard, K. I. (1982). *The Offer Self-Image Questionnaire for Adolescents: A Manual.* Chicago: Michael Reese Hospital.

Olderbak, S. G., & Figueredo, A. J. (2009). Predicting romantic relationship satisfaction from life history strategy. *Personality and Individual Differences*, 46, 604–610. doi:10.1016/j.paid.2008.12.019

Olderbak, S.G. and Figueredo, A.J. (2010). Life history strategy as a longitudinal predictor of relationship satisfaction and dissolution. *Personality and Individual Differences, 49*, 234-239. doi:10.1016/j.paid.2010.03.041.

Olderbak, S., & Figueredo, A. J. (2012). Shared life history strategy as a strong predictor of romantic relationship satisfaction. *Journal of Social, Evolutionary and Cultural Psychology*, 6, 111–131. doi:10.1037/h0099221

Olderbak, S.G., Gladden, P., Wolf, P.S.A. and Figueredo, A.J. (2014). Comparison of life history strategy measures. *Personality and Individual Differences*, 58, 82-88. doi:10.1016/j.paid.2013.10.012

Osterman, K., Bjorkqvist, K., Lagerspetz, K.M.J., Kaukiainen, A., Landau, S.F., Fraczek, A., & Caprara, G.V. (1998). Cross cultural evidence of female indirect aggression. *Aggressive Behavior*, 1, 1-8. doi:10.1002/(SICI)1098-2337(1998)24:1<1::AID-AB1>3.0.CO;2-R

*Overman, W.H., Frassrand, K., Ansel, S., Trawalter, S., Bies, B., & Redmond, A. (2004). Performance on the IOWA card task by adolescents and adults. *Neuropsychologia*, 42, 1838-1851. doi:10.1016/j.neuropsychologia.2004.03.014

*Owsley, C., McGwin, G., & McNeal, S.F. (2003). Impact of impulsiveness, venturesomeness, and empathy on driving by older adults. *Journal of Safety Research*, 34, 353-359. doi:10.1016/j.jsr.2003.09.013

*Paaver, M., Nordquist, N., Parik, J., Harro, M., Oreland, L., & Harro, J. (2007). Platelet MAO activity and the 5-HTT gene promoter polymorphism are associated with impulsivity and cognitive style in visual information processing. *Psychopharmacology*, 194, 545–554. doi:10.1007/s00213-007-0867-z

Pampel, F. C. (2001). Gender equality and the sex differential in mortality from accidents in high income nations. *Population Research and Policy Review, 20,* 397-421. doi:10.1023/A:1013307620643

*Pang, J.S., & Schultheiss, O.C. (2005). Assessing implicit motives in U.S. college students: Effects of picture type and position, gender and ethnicity, and cross-cultural comparisons. *Journal of Personality Assessment*, 85, 280-294. doi:10.1207/s15327752jpa8503_04

Parsey, R., Oquendo, M., Simpson, N., Ogden, R., Heertum, R.V., Arango, V., et al. (2002). Effects of sex, age and aggressive traits in man on brain serotonin 5-HT1A receptor binding potential measured by PET using [C-11]WAY-100635. *Brain Research*, 954, 173-182. doi:10.1016/S0006-8993(02)03243-2

*Patock-Peckham, J.A., & Morgan-Lopez, A.A. (2006). College drinking behaviors: Mediational links between parenting styles, impulse control, and alcohol-related outcomes. *Psychology of Addictive Behaviors*, 20, 117-125. doi:10.1037/0893-164X.20.2.117

*Patock-Peckham, J.A., Hutchinson, G.T., Cheong, J., & Nagoshi, C.T. (1998). Effect of religion and religiosity on alcohol use in a college student sample. *Drug and Alcohol Dependence*, 49, 81-88. doi:10.1016/S0376-8716(97)00142-7

Patterson, C.M., & Newman, J.P. (1993). Reflectivity and learning from aversive events: Toward a psychological mechanism for the syndromes of disinhibition. *Psychological Review*, 100, 716-736. doi:10.1037/0033-295X.100.4.716

*Patton, J.H., Stanford, M.S., & Barratt, E.S. (1995). Factor structure of the Barratt Impulsiveness Scale. *Journal of Clinical Psychology*, 51, 768-719. doi:10.1002/1097-4679(199511)51:6<768::AID-JCLP2270510607>3.0.CO;2-1

Paukku, M., Quan, J., Darney, P., & Raine, T. (2003). Adolescents' contraceptive use and pregnancy history: is there a pattern? *Obstetrics and Gynaecology*, 3, 534-538. doi:10.1016/S0029-7844(02)02717-5

Paulsen, K., & Johnson, M. (1980). Impulsivity: A multidimensional concept with developmental aspects. *Journal of Abnormal Child Psychology*, 8, 269-277. doi:10.1007/BF00919070

*Pearson, P.R., Francis, L.J., & Lightbrown, T.J. (1986). Impulsivity and religiosity. *Personality and Individual Differences*, 7, 89-94. doi:10.1016/0191-8869(86)90112-1

Pederson, F.A. (1991). Secular trends in human sex ratios: their influence on individual and family behaviour. *Human Nature*, 2, 271-291. doi:10.1007/BF02692189

*Peluso, M.A.M., Hatch, J.P., Glahn, D.C., Monkul, E.S., Sanches, M., Najt, P., et al. (2007). Trait impulsivity in patients with mood disorders. *Journal of Affective Disorders*, 100, 227-231. doi:10.1016/j.jad.2006.09.037

*Penas-Lledo, E., de Dios Fernandez, J., & Waller, G. (2004). Association of anger with bulimic and other impulsive behaviours among non-clinical women and men. *European Eating Disorders Review*, 12, 392-397. doi:10.1002/erv.588

Penke, L. (2009). Bridging the gap between modern evolutionary psychology and the study of individual differences. In Buss, D.M. & Hawley, P.H. (Eds). *The Evolution of Personality and Individual Differences*. New York: Oxford University Press.

Penke, L., & Asendorpf, J.B. (2008). Beyond global sociosexual orientations: a more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology,* 95, 1113-1135. doi:10.1037/0022-3514.95.5.1113

Penke, L., Denissen, J.A., & Miller, G. F. (2007a). The evolutionary genetics of personality. *European Journal of Personality*, 21, 549–587. doi:10.1002/per.629

Penke, L., Denissen, J.A., & Miller, G. F. (2007b). Evolution, genes and interdisciplinary personality research. *European Journal of Personality*, 21, 639–665. doi:10.1002/per.657

Pennington, R. & Harpending, H. (1993). *The Structure of an African Pastoralist Community: Demography, History and Ecology of the Ngamiland Herero*. Oxford: Oxford University Press.

*Perez, J., & Torrubia, R. (1985). Sensation seeking and antisocial behaviour in a student sample. *Personality and Individual Differences*, 6, 401-403. doi:10.1016/0191-8869(85)90068-6

Perkins, A., & Corr, P. J. (2006). Reactions to threat and personality: Psychometric differentiation of intensity and direction dimensions of human defensive behavior. *Behavioral and Brain Researc*h, 169, 21−28. doi:10.1016/j.bbr.2005.11.027

Perry, B.D. (1997). Incubated in Terror: Neurodevelopmental Factors in the 'Cycle of Violence'. In Osofsky, J. (ed). *Children, Youth and Violence: The Search for Solutions*. Guilford Press, New York, pp 124-148.

Perusse, D. (1993). Cultural and reproductive success in industrial societies: Testing the relationship at the proximate and ultimate levels. *Behavioral and Brain Sciences*, 16, 267-322. doi:10.1017/S0140525X00029939

Pesonen, A.-K., Ra¨ikkönen, K., Heinonen, K., Kajantie, E., Forse´n, T., & Eriksson, J. G. (2008). Reproductive traits following a parent– child separation trauma during childhood: A natural experiment during World War II. *American Journal of Human Biology*, 20, 345–351. doi:10.1002/ajhb.20735

*Petry, N.M., Kirby, K.N., & Kranzler, H.R. (2002). Effects of gender and family history of alcohol dependence on a behavioral task of impulsivity in healthy subjects. *Journal of Studies on Alcohol, 63,* 83-90.

*Pfefferbaum, B., & Wood, P.B. (1994). Self report study of impulsive and delinquent behavior in college students. *Journal of Adolescent Health*, 15, 295-302. doi:10.1016/1054-139X(94)90602-5

Pheasant, S. T. (1983) Sex differences in strength – some observations on their variability. *Applied Ergonomics*, 14, 205–11. doi:10.1016/0003-6870(83)90083-2

Pianka, E.R. (1970). On "r" and "K" selection. *American Naturalist*, 104, 592-597. doi:10.1086/282697

Pickett, K.E., Mookherjee, J., & Wilkinson, R.G. (2005). Adolescent birth rates, total homicides and income equality in rich countries. *American Journal of Public Health,* 95, 1181-1183. doi: 10.2105/AJPH.2004.056721

Piquero, A. R., & Rosay, A. B. (1998). The reliability and validity of Grasmick et al.'s self-control scale: A comment on Longshore et al. *Criminology*, 36, 157-174. doi:10.1111/j.1745-9125.1998.tb01244.x

*Plastow, R.L. (2007). Lifestyle and chronic illness: Variables affecting risk perception. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 67, (7-B), 4093.

Plavcan, J. M. (2001). Sexual dimorphism in primate evolution**.** *Yearbook of Physical Anthropology*, 44, 25-53. doi:10.1002/ajpa.10011.abs

Plomin, R., & Daniels, D. (1987). Why are children in the same family so different from each other? *Behavioral and Brain Sciences,* 10, 1-16. doi:10.1017/S0140525X00055941

Plotkin, H. (1994). *Darwin Machines and the Nature of Knowledge*. Penguin: London.

Plotkin, H. (2007). The power of culture. In Dunbar, R.I.M., & Barrett, L. (Eds*). The Oxford Handbook of Evolutionary Psychology*. Oxford: Oxford University Press.

*Plouffe, L., & Gravelle, F. (1989). Age, sex and personality correlates of self actualization in elderly adults. *Psychological Reports*, *65,* 643-647. doi:10.2466/pr0.1989.65.2.643

*Pompili, M., Innamorati, M., Lester, D., Brunetti, S., Tatarelli, R., & Girardi, P. (2007). Gender effects among undergraduates relating to suicide risk, impulsivity, aggression and self-efficacy. *Personality and Individual Differences*, 43, 2047-2056. doi:10.1016/j.paid.2007.06.019

*Pontzer, D.P. (2007). Testing reintegrative shaming theory as an explanation for involvement in bullying among university students: Parenting, personality, and the dyadic relationship between bullies and their victims. *Dissertation Abstracts International Section A: Humanities and Social Sciences,* 68, (3-A), 1171.

Porteus, S.D. (1950). *The Porteus Maze Test and intelligence*. Pacific Books, Palo Alto.

Posner, M.I., & Rothbart, M.K. (2009). Toward a physical basis of attention and self-regulation. *Physics of Life Reviews*, 6, 103-120. doi:10.1016/j.plrev.2009.02.001

Pratt, T. C., & Cullen, F. T. (2000). The empirical status of Gottfredson and Hirschi's general theory of crime: A meta-analysis. *Criminology*, 38, 931-964. doi:10.1111/j.1745-9125.2000.tb00911.x

Promislow, D. E. L. and Harvey, P. H. (1990). Living fast and dying young: a comparative analysis of life history variation among mammals. *Journal of Zoology*, 220, 417–437. doi:10.1111/j.1469-7998.1990.tb04316.x

Promislow, D. E. L., and Harvey, P. H. (1991). Mortality rates and the evolution of mammal life histories. *Acta Oecologica – International Journal of Ecology*, 12, 119-137.

Puts, D. A. (2005). Mating context and menstrual phase affect women's preferences for male voice pitch. *Evolution and Human Behavior*, 26, 388-397. doi:10.1016/j.evolhumbehav.2005.03.001

Puts, D. A., Gaulin, S. J. C. & Verdolini, K. (2006). Dominance and the evolution of sexual dimorphism in human voice pitch. *Evolution and Human Behavior*, 27, 283–296. doi:10.1016/j.evolhumbehav.2005.11.003

Quilty, L. C., & Oakman, J. M. (2004). The assessment of behavioural activation: The relationship between impulsivity and behavioural activation. *Personality and Individual Differences*, 37, 429–442. doi:10.1016/j.paid.2003.09.014

Quinlan, R. J. (2003). Father absence, parental care, and female reproductive development. *Evolution and Human Behavior*, 24, 376 – 390. doi:10.1016/S1090-5138(03)00039-4

Quinlan, R.J. (2003). Father absence, parental care, and female reproductive development. *Evolution and Human Behavior*, 24, 376 – 390. doi:10.1016/S1090-5138(03)00039-4

Quinlan, R.J. (2010). Extrinsic Mortality Effects on Reproductive Strategies in a Caribbean Community. *Human Nature*, 21, 124-139. doi:10.1007/s12110-010-9085-1

Quinlivan, J.A., Tan, L.H., Steele, A., & Black, K. (2004). Impact of demographic factors, early family relationships and depressive symptomatology in teenage pregnancy. *Australian and New Zealand Journal of Psychiatry*, 38, 197-203. doi:10.1111/j.1440-1614.2004.01336.x

*Quiroga, M.A., Hernandez, J.M., Rubio, V., Shih, P.C., Santacreu, J., & Howard, V.N. (2007). Influence of impulsivity-reflexivity when testing dynamic spatial ability: Sex and g differences. *The Spanish Journal of Psychology*, 10, 294-302. doi:10.1017/S1138741600006569

Raffaelli, M., & Crockett, L.C. (2003). Sexual risk taking in adolescence: The role of self-regulation and attraction to risk. *Developmental Psychology*, 39, 1036-1046. doi:10.1037/0012-1649.39.6.1036

Raine, A., Reynolds, C., Venables, P.H., Mednick, S.A., Farrington, D.P. (1998). Fearlessness, stimulation-seeking, and large body size at age 3 years as early predispositions to childhood aggression at age 11 years. *Archives of General Psychiatry*, 55, 745–751. doi:10.1001/archpsyc.55.8.745

*Ramadan, R., & McMurran, M. (2005). Alcohol and aggression: Gender differences in their relationships with impulsiveness, sensation seeking and social problem solving. *Journal of Substance Use*, 10, 215-224. doi:10.1080/14657890412331319454

*Rammsayer, T. H., & Rammstedt, B. (2000). Sex-related differences in time estimation: The role of personality. *Personality and Individual Differences*, 29, 301-312. doi:10.1016/S0191-8869(99)00194-4

*Rawlings, D. (1984). The correlation of EPQ Psychoticism with two behavioural measures of impulsivity. *Personality and Individual Differences*, 5, 591-594. doi:10.1016/0191-8869(84)90034-5

Read, D., and Read, N.L. (2004). Time discounting over the lifespan. *Organizational Behavior and Human Decision Processes*, 94, 22-32. doi:10.1016/j.obhdp.2004.01.002

*Reeve, C.L. (2007). Functional impulsivity and speeded ability test performance. *International Journal of Selection and Assessment*, 15, 56-62. doi:10.1111/j.1468-2389.2007.00367.x

Reif, A., Kiive, E., Kurrikoff, T., Paaver., Herterich, S., Konstabel., Tulviste., Lesch, K., and Harro, J. (2011). A functional NOS1 promotor polymorphism interacts with adverse environment on functional and dysfunctional impulsivity. *Psychopharmocology*, 214, 239-248. doi:10.1007/s00213-010-1915-7

Reimers, S., Maylor, E.A., Stewart, N., and Chater, N. (2009). Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior. *Personality and Individual Differences*, 47, 973-978. doi: 10.1016/j.paid.2009.07.026

Reitan R. M. (1958). Validity of the Trail Making test as an indicator of organic brain damage. *Perceptual and Motor Skills*, 8, 271-276. doi:10.2466/PMS.8.7.271-276

*Reto, C.S., Dalenberg, C.J., & Coe, M.T. (1993). Dissociation and physical abuse as predictors of bulimic symptomatology and impulse dysregulation. *Eating Disorders: The Journal of Treatment and Prevention*, 1, 229-239. doi:10.1080/10640269308251162

*Reynolds, B. (2003). Impulsivity and friends who smoke as predictors of adolescent smoking. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 63, (12-B), 6122.

*Reynolds, B., Ortengren, A., Richards, J.B., & de Wit, H. (2006). Dimensions of impulsive behaviour: Personality and behavioural measures. *Personality and Individual Differences*, 40, 305-315. doi:10.1016/j.paid.2005.03.024

*Reynolds, B., Patak, M., Shroff, P., Penfold, R.B., Melanko, S., & Duhig, A.M. (2007). Laboratory and self-report assessments of impulsive behaviour in adolescent daily smokers and non smokers. *Experimental and Clinical Psychopharmacology*, 15, 264-271. doi: 10.1037/1064-1297.15.3.264

Reynolds, B., Penfold, R.B., & Patak, M. (2008). Dimensions of impulsive behavior in adolescents: Laboratory behavioral assessments. *Experimental and Clinical Psychopharmacology,* 16, 124–131. doi:10.1037/1064-1297.16.2.124

*Reynolds, B., Richards, J.B., & de Wit, H. (2006). Acute-alcohol effects on the experiential discounting task (EDT) and a question-based measure of delay discounting. *Pharmacology, Biochemistry and Behavior*, 83, 194-202. doi:10.1016/j.pbb.2006.01.007

*Reynolds, B., Richards, J.B., Horn, K., & Karraker, K. (2004). Delay discounting and probability discounting as related to cigarette smoking status in adults. *Behavioural Processes*, 65, 35-42. doi:10.1016/S0376-6357(03)00109-8

Rhee, S.H. & Waldman, I.D. (2007). Behavior-genetics of criminality and aggression. In Flanner, D.J., Vazsonyi, A.T., & Waldman, I.D. (Eds). *The Cambridge Handbook of Violent Behavior and Aggression* (pp. 77-90). Ney York: Cambridge University Press

*Rhyff, C.D.M., & Heincke, S.G. (1983). Subjective organization of personality in adulthood and aging. *Journal of Personality and Social Psychology*, 44, 807-816. doi:10.1037/0022-3514.44.4.807

Richards, J. B., Zhang, L., Mitchell, S. H., & de Wit, H. (1999). Delay or probability discounting in a model of impulsive behavior: Effect of alcohol. *Journal of the Experimental Analysis of Behavior,* 71, 121-143. doi:10.1901/jeab.1999.71-121

Richardson, D.R., & Green, L.R. (2003). Defining Direct and Indirect Aggression: The Richardson Conflict Response Questionnaire. *International Review of Social Psychology*, 16, 11-30.

Rickard, I. J., Frankenhuis, W. E., & Nettle, D. (2014). Why are childhood family factors associated with timing of maturation: The role for internal prediction. *Perspectives in Psychological Science*, 9, 3–15. doi:10.1177/1745691613513467

*Rigby, K., Mak, A.S., & Slee, P.T. (1989). Impulsiveness, orientation to institutional authority, and gender as factors in self reported delinquency among Australian adolescents. *Personality and Individual Differences*, 10, 689-692. doi:10.1016/0191-8869(89)90228-6

*Rigby, K., Slee, P., & Mak, A. (1992). Impulsiveness, attitude to authority, and gender. *Psychological Reports*, 71, 121-122. doi:10.2466/PR0.71.5.121-122

*Rim, Y. (1994). Impulsivity, venturesomeness, empathy and schizotypy. *Personality and Individual Differences*, 17, 853-854. doi:10.1016/0191-8869(94)90053-1

*Robinson, T.N. (1990). Eysenck personality measures and religious orientation. *Personality and Individual Differences*, 11, 915-921. doi:10.1016/0191-8869(90)90272-S

Robinson, V. (2008). *Everyday Masculinities and Extreme Sports: Male Identity and Rock Climbing.* Oxford: Berg.

Robinson, W.S. (1950). Ecological correlations and the behaviour of individuals. *American Sociological Review*, 15, 351-357. doi:10.2307/2087176

Rodgers, J.L., Hughes, K., Kohler, H.-P., Christensen, K., Doughty, D., Rowe, D.C., et al. (2001). Genetic differences help explain differences in human fertility outcomes: Evidence from recent behavioural and molecular genetic studies. *Current Directions in Psychological Science*, 10, 184-188. doi:10.1111/1467-8721.00145

Rodriguez-Fornells, A., Lorenzo-Seva, U., & Andres-Pueyo, A. (2002). Are high-impulsive and high risk-taking people more motor disinhibited in the presence of incentive? *Personality and Individual Differences*, 32, 661-683. doi:10.1016/S0191-8869(01)00068-X

Roff, D.A. (1992). *The Evolution of Life Histories: Theory and Analysis*. New York: Chapman and Hall.

Rohner, R. (1976). Sex differences in aggression: Phylogenetic and enculturation perspectives. *Ethos*, 4, 57-72. doi:10.1525/eth.1976.4.1.02a00030

Rolls, E. T. (2000). The orbitofrontal cortex and reward. *Cerebral Cortex*, 10, 284–294. doi:10.1093/cercor/10.3.284

*Romero, E., Luengo, M.A., & Sobral, J. (2001). Personality and antisocial behaviour: Study of temperamental dimensions. *Personality and Individual Differences*. 31, 329-348. doi:10.1016/S0191-8869(00)00139-2

Rood, L., Roelofs, J., Bogels, S., Nolen-Hoeksema, S. & Schouten, E. (2009). The influence of emotion-focused rumination and distraction on depressive symptoms in non-clinical youth: A meta-analytic review. *Clinical Psychology Review*, 29, 607–616. doi:10.1016/j.cpr.2009.07.001

Rose, P. (2007). Mediators of the association between narcissism and compulsive buying: The roles of materialism and impulse control. *Psychology of Addictive Behaviors*, 21, 576-581. doi:10.1037/0893-164X.21.4.576

Ross, L. T., & Hill, E. M. (2002). Childhood unpredictability, schemas for unpredictability and risk taking. *Social Behavior and Personality*, 30, 453–474. doi:10.2224/sbp.2002.30.5.453.

Ross, L.T. & McDuff, J.A. (2008). The retrospective family unpredictability scale: Reliability and validity. *Journal of Child and Family Studies*, 17, 13-27. doi:10.1007/s10826-007-9138-1

Ross, S.R., Molto, J., Poy, R., Segarra, P. Pastor, M.C. & Montanes, S. (2007). Gray's model and psychopathy: BIS but not BAS differentiates primary from secondary psychopathy in noninstitutionalized young adults. *Personality and Individual Differences*, 43, 1644-1655. doi:10.1016/j.paid.2007.04.020

*Roth, M., Hammelstein, P., & Brahler, E. (2007). Beyond a youthful behavior style: Age and sex differences in sensation seeking based on need theory. *Personality and Individual Differences*, 43, 1839-1850. doi:10.1016/j.paid.2007.06.004

Rothbart, M.K. (2007). Temperament, development and personality. *Current Directions in Psychological Science*, 16, 207-212. doi:10.1111/j.1467-8721.2007.00505.x

Rothbart, M.K., Ahadi, S.A., & Evans, D.E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology*, 78, 122-135. doi:10.1037/0022-3514.78.1.122

Rothbart, M.K., & Bates, J.E. (2006). Temperament. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99–166). New York: Wiley.

Rothbart, M.K., & Derryberry, D. (1981). Development of individual differences in temperament. In M.E. Lamb & A. Brown (Eds.), *Advances in developmental psychology* (Vol. 1, pp. 37–86). Hillsdale, NJ: Erlbaum.

Rothbart, M.K., & Posner, M.I. (2006). Temperament, attention, and developmental psychopathology. In D. Cicchetti & D. Cohen (Eds.), *Developmental psychopathology: Vol. 2. Developmental Neuroscience* (2nd ed., pp. 465–501). New York: Wiley.

Rowe, D. C. (1996). An adaptive strategy theory of crime and delinquency. In Hawkins, D. (Ed.). *The Current Theories of Delinquency and Crime*. Newbury Park, CA: Sage.

Rowe, D.C. (2000). Environmental and genetic influences on pubertal development: Evolutionary life history traits? In Rodgers, J.L. Rowe, D.C. & Miller, W.B. (Eds.). *Genetic Influences on Human Fertility and Sexuality: Recent Empirical and Theoretical Findings* (pp. 147-168). Boston: Kluwer.

Rowe, D. C. (2002). On genetic variation in menarche and age at first sexual intercourse. *Evolution and Human Behavior*, 23, 365–372. doi:10.1016/S1090-5138(02)00102-2.

Rowe, D. C., Vazsonyi, A. T., & Figueredo, A. J. (1997). Mating-effort in adolescence: conditional or alternative strategy? P*ersonality and Individual Differences*, 23, 105–115. doi:10.1016/S0191-8869(97)00005-6

Rowe, D.C., Vazsonyi, A.T., & Flannery, D.J. (1995). Sex differences in crime: Do means and within-sex variation have similar causes? *Journal of Research in Crime and Delinquency*, 32, 84-100. doi:10.1177/0022427895032001004

Rushton, J. P. (1985). Differential K theory: The sociobiology of individual and group differences. *Personality and Individual Differences*, 6, 441–452. doi:10.1016/0191-8869(85)90137-0

Rushton, J. P. (1995). *Race, Evolution and Behavior*. New Brunswick, NJ, Transaction Publishers.

Rushton, J.P. (2013). Intelligence: A unifying explanatory construct for the social sciences. *Personality and Individual Differences*, 54, 318, doi:10.1016/j.paid.2012.08.018

Rushton, J. P., Bons, T. A., & Hur, Y.-M. (2008). The genetics and evolution of the general factor of personality. *Journal of Research in Personality*, 42, 1173–1185. doi:10.1016/j.jrp.2008.03.002

Rushton, J.P. and Irwing, P. (2008). A general factor of personality (GFP) from two meta-analyses of the Big Five: Digman (1997) and Mount, Barrick, Scullen and Rounds (2005). *Personality and Individual Differences*, 45, 679-683. doi:10.1016/j.paid.2008.07.015

Rushton, J. P., & Irwing, P. (2011). The general factor of personality: Normal and abnormal. In Chamorro-Premuzic, T., von Stumm, S., & Furnham, A. (Eds.), *The Wiley-Blackwell Handbook of Individual Differences* (pp. 132–161). London: Wiley–Blackwell.

Sabates, R. (2008). Educational attainment and juvenile crime. Area-level evidence using three cohorts of young people. *British Journal of Criminology*, 48, 395-409. doi:10.1093/bjc/azn003

*Sahoo, M.K. (1985). Prediction of personality dimensions and risk taking behavior. *Perspectives in Psychological Research*, 8, 57-62.

*Saklofske, D.H., & Eysenck, S.B.G. (1983). Impulsiveness and venturesomeness in Canadian children. *Psychological Reports*, 52, 147-152. doi:10.2466/pr0.1983.52.1.147

Salmivalli, C., Kaukiainen, A., & Lagerspetz, K. (2000). Aggression and sociometric status among peers: Do gender and type of aggression matter? *Scandinavian Journal of Psychology*, 41, 17-24. doi:10.1111/1467-9450.00166

Salmon, C., Figueredo, A. J., & Woodburn, L. (2009). Life history strategy and disordered eating behavior. *Evolutionary Psychology*, 7, 585–600.

Sameroff, A. J., Seifer, R., Barocas, R., Zax, M., & Greenspan, S. (1987). Intelligence quotient scores of 4-year-old children: Social-environmental risk factors. *Pediatrics*, 79, 343–350.

Sampson, R.J. & Laub, J.H. (2003). Life-Course Desisters? Trajectories of crime among delinquent boys followed to age 70. *Criminology*, 41, 319-339. doi:10.1111/j.1745-9125.2003.tb00997.x

Santelli, J.S., Morrow, B., Anderson, J.E., & Duberstein Lindberg, L. (2006). Contraceptive use and pregnancy risk among U.S. high school students, 1991-2003. *Perspectives on Sexual and Reproductive Health*, 38, 106-111. doi: 10.1111/j.1931-2393.2006.tb00067.x

*Sasaki, H., & Kanachi, M. (2005). The effects of trial repetition and individual characteristics on decision making under uncertainty. *Journal of Psychology: Interdisciplinary and Applied*, 139, 233-246. doi:10.3200/JRLP.139.3.233-246

Satorra, A., and Bentler, P.M. (1988). Scaling corrections for chi square statistics in covariance structure analysis. *American Statistical Association 1988 Proceedings of the Business and Economic Sections* (pp. 308-313). Alexandria, VA: ASA.

Scaramella, L. V., Conger, R. D., Simons, R. L., & Whitbeck, L. (1998). Predicting risk for pregnancy by late adolescence: A social contextual perspective. *Developmental Psychology*, 34, 1233–1245. doi:10.1037/0012-1649.34.6.1233

Schaffer,W. (1983). The application of optimal control theory to the general life history problem. *American Naturalist*, 121, 418–431. doi:10.1086/284070.

Schaller, M., & Murray, D. R. (2008). Pathogens, personality and culture: disease prevalanece predicts worldwide variability in sociosexuality, extraversion and openness to experience. *Journal of Personality and Social Psychology*, 95, 212–221. doi:10.1037/0022-3514.95.1.212.

Schaller, M., & Murray, D. R. (2008). Pathogens, personality and culture: disease prevalence predicts worldwide variability in sociosexuality, extraversion and openness to experience. *Journal of Personality and Social Psychology*, 95, 212–221. doi:10.1037/0022-3514.95.1.212.

Schalling, D. (1978). Psychopathy-related personality variables and the psychophysiology of socialization. In Hare, R.D. & Schalling, D. (Eds.) *Psychopathic Behaviour: Approaches to Research*, pp. 85-106. Chichester: John Wiley and Sons.

*Schaughency, E., McGee, R., Shyamala, N., Feehan, M., & Silva, P.A. (1994). Self reported inattention, impulsivity and hyperactivity at ages 15 and 18 in the general population. *Journal of the American Academy of Child and Adolescent Psychiatry*, 33, 173-184. doi:10.1097/00004583-199402000-00004

Schechter, D.E. & Francis, C.M. (2010). A life history approach to understanding youth time preference. *Human Nature*, 21, 140-164. doi:10.1007/s12110-010-9084-2

Schmitt, D.P. (2005). Sociosexuality from Argentina to Zimbabwe: A 48 nation study of sex, culture, and strategies of human mating. *Behavioral and Brain Sciences*, 28, 247-311. doi:10.1017/S0140525X05000051

Schmitt, D. P., Alcalay, L., Allensworth, M., Allik, J., Ault, L., Austers, I., et al. (2004). Patterns and universals of adult romantic attachment across 62 cultural regions. Are models of self and others pancultural constructs? *Journal of Cross-Cultural Psychology,* 35, 367–402. doi:10.1177/0022022104266105

Schmitt, D.P., Realo, A., Voracek, M., & Allik, J. (2008). Why can't a man be more like a woman? Sex differences in Big Five personality traits across 55 cultures. *Journal of Personality and Social Psychology*, 94, 168–182. doi:10.1037/a0014651

Schmitt, D.P., Shackelford, T.K., Duntley, J., Tooke, W., Buss, D.M., Fisher, M.L., Lavallee, M., & Vasey, P. (2002). Is there an early 30s peak in female sexual desire? Cross-sectional evidence from the United States and Canada. *The Canadian Journal of Human Sexuality*, 11, 1-18.

Schulze, R. (2004). *Meta-Analysis: A Comparison of Approaches.* Lower Saxony, Germany: Hogrege & Huber.

Schwartz, J.E., Friedman, H.S., Tucker, J.S., Tomilinson-Keasey, C., Wingard, D.L., & Criqui, M.H. (1995). Sociodemographic and psychosocial factors in childhood as predictors of adult mortality. *American Journal of Public Health*, 85, 1237-1245. doi:10.2105/AJPH.85.9.1237

*Schwartz, S.J. (2007). The structure of identity consolidation: Multiple correlated constructs of one superordinate construct? *Identity*, 7, 27-49. doi:10.1080/15283480701319583

*Schweizer, K. (2002). Does impulsivity influence performance in reasoning? *Personality and Individual Differences*, 33, 1031-1043. doi:10.1016/S0191-8869(01)00209-4

Sear, R. & Mace, R. (2008). Who keeps children alive? A review of the effects of kin on child survival. *Evolution and Human Behavior*, 29, 1-18. doi:10.1016/j.evolhumbehav.2007.10.001

*Segarra, P., Ross, S.R., Pastor, M.C., Montanes, S., Poy, R., & Molto, J. (2007). MMPI-2 predictors of Gray's two-factor reinforcement sensitivity theory. *Personality and Individual Differences*, 43, 437-448. doi:10.1016/j.paid.2006.12.013

Seifer, R., Sameroff, A. J., Dickstein, S., Keitner, G., Miller, I., Rasmussen, S., & Hayden, L. C. (1996). Parental psychopathology, multiple contextual risks, and one-year outcomes in children. *Journal of Clinical Child Psychology*, 25, 423–435. doi:10.1207/s15374424jccp2504_7

Seto, M.C., Lalumiere, M.L., & Quinsey, V.L. (1995). Sensation seeking and males' sexual strategy. *Personality and Individual Differences*, 19, 669-675. doi:10.1016/0191-8869(95)00101-B

Shaller, M. & Murray, D.R. (2008). Pathogens, personality and culture: disease prevalanece predicts worldwide variability in sociosexuality, extraversion and openness to experience. *Journal of Personality and Social Psychology*, 95, 212-221. doi: 10.1037/0022-3514.95.1.212

Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences*, 298, 199-209. doi:10.1098/rstb.1982.0082

Sheldon, B.C., Merila, J., Qvarnstrom, A., Gustafsson, L., & Ellegren, H. (1997). Paternal genetic contribution to offspring condition predicted by size of male secondary sexual character. *Proceedings of the Royal Society of London B*, 264, 297-302. doi:10.1098/rspb.1997.0042

Shepherd, J. (1990). Violent crime in Bristol - an Accident and Emergency Department perspective. *British Journal of Criminology, 30*, 289-305

Sheppard, P., Garcia J.R., & Sear, R. (2014). A not-so-grim tale: How childhood family structure influences reproductive and risk taking outcomes in a historical U.S. population. *PLOS One*, 9, e89539. doi:10.1371/journal.pone.0089539

Sheppard, P., Schaffnit, S.B., Garcia J.R., & Sear, R. (2014). Fostering relations: first sex and marital timings of children raised by kin and non-kin carers. *Evolution and Human Behavor*, 35, 161-168. doi:10.1016/j.evolhumbehav.2013.12.002

Sheppard, P. & Sear, R. (2011). Father absence predicts age at sexual maturity and reproductive timetable in British men. *Biology Letters*, 8, 237-240. doi:10.1098/rsbl.2011.0747

Sherman, R.A., Figueredo, A.J. & Funder, D.C. (2013). The behavioural correlates of overall and distinctive life history strategy. *Journal of Personality and Social Psychology*, 105, 873-888. doi:10.1037/a0033772

*Sigurdsson, J.F., Gudjonsson, G.H., Bragason, A.V., Kristjansdottir, E., & Sigfusdottir, I.D. (2006). The role of violent cognition in the relationship between personality and the involvement in violent films and computer games. *Personality and Individual Differences*, 41, 381-392. doi:10.1016/j.paid.2006.02.006

Simo, S. & Perez, J., (1991). Sensation seeking and antisocial behaviour in a junior sample. *Personality and Individual Differences*, 12, 965-966. doi:10.1016/0191-8869(91)90186-F

*Simo, S., Santana, G., & Perez, J. (1991). A French Junior Sensation Seeking Scale (J-SSS). *Personality and Individual Differences*, 12, 669-670. doi:10.1016/0191-8869(91)90221-V

*Simons, J.S. (2003). Differential prediction of alcohol use and problems: The role of biopsychological and social-environmental variables. *American Journal of Drug and Alcohol Abuse*, 29, 861-879. doi:10.1081/ADA-120026265

*Simons, J.S., & Carey, K.B. (2006). An affective and cognitive model of marijuana and alcohol problems. *Addictive Behaviors*, 31, 1578-1592. doi:10.1016/j.addbeh.2005.12.004

*Simons, J.S., Carey, K.B., & Gaher, R.M. (2004). Lability and impulsivity synergistically increase risk for alcohol-related problems. *American Journal of Drug and Alcohol Abuse*, 30, 685-694. doi:10.1081/ADA-200032338

*Simons, J.S., Gaher, R.M., Correia, C.J., Hansen, C.L., & Christopher, M.S. (2005). An affective-motivational model of marijuana and alcohol problems among college students. *Psychology of Addictive Behaviours*, 19, 326-334. doi:10.1037/0893-164X.19.3.326

Simpson, J.A., & Gangestad, S.W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology*, 60, 870-883. doi:10.1037/0022-3514.60.6.870

Singh, S., Darroch, J.E., & Frost, J.J. and the Study Team (2001). Socioeconomic disadvantage and adolescent women's sexual and reproductive behavior: The case of five developed countries. *Family Planning Perspectives*, 33, 251-289. doi:10.2307/3030192

Slobodkin, L., & Rapoport, A. (1974). An Optimal Strategy of Evolution. *Quarterly Review of Biology*, 49, 181-200. doi:10.1086/408082

Smillie, L.D. (2008). What is reinforcement sensitivity? Neuroscience paradigms for approach-avoidance process theories of personality. *European Journal of Personality*, 22, 359-384. doi:10.1002/per.674

*Smillie, L.D., Jackson, C.J., & Dalgleish, L.I. (2006). Conceptual distinctions among Carver and White's (1994) BAS scales: A reward-reactivity versus trait impulsivity perspective. *Personality and Individual Differences*, 40, 1039-1050. doi:10.1016/j.paid.2005.10.012

Smith, C.L. & Hantula, D.A. (2008). Methodological considerations in the study of delay discounting in intertemporal choice: A comparison of tasks and modes. *Behavior Research Methods*, 40, 940-953. doi:10.3758/BRM.40.4.940

Smith, G. T., Fischer, S., Cyders, M. A., Annus, A. M., Spillane, N. S., & McCarthy, D.M. (2007). On the validity and utility of discriminating among impulsivity-like traits. *Assessment*, 14, 155-170. doi:10.1177/1073191106295527

Smith, P., Waterman, M., & Ward, N. (2006). Driving aggression and non-forensic population: relationships to self-reported levels of aggression, anger and impulsivity. *British Journal of Psychology*, 97, 387-403. doi:10.1348/000712605X79111

*Smith, P., Waterman, M., & Ward, N. (2006). Driving aggression in forensic and non-forensic populations: Relationships to self-reported levels of aggression, anger and impulsivity. *British Journal of Psychology*, 97, 387-403. doi:10.1348/000712605X79111

*Soloff, P.H., Kelly, T.M., Strotmeyer, S.J., Malone, K.M., & Mann, J.J. (2003). Impulsivity, gender, and response to fenfluramine challenge in borderline personality disorder. *Psychiatry Research*, 119, 11-24. doi:10.1016/S0165-1781(03)00100-8

South, S.J., & Messner, S.F. (1987). The sex ratio and women's involvement in crime: a cross-national analysis. *The Sociological Quarterly*, 28, 171-188. doi: 10.1111/j.1533-8525.1987.tb00289.x

*Spence, J.T., Losoff, M., & Robbins, A.S. (1991). Sexually aggressive tactics in dating relationships: Personality and attitudinal correlates. *Journal of Social and Clinical Psychology*, 10, 289-304. doi:10.1521/jscp.1991.10.3.289

*Spillane, N.S., & Smith, G.T. (2006a). *Empirical support for a multifaceted model of American Indian drinking.* Paper presented at the annual international meeting of the Research Society on Alcoholism, Baltimore, MD.

*Spillane, N.S., & Smith, G.T. (2006b). *Personality risk for smoking behavior.* Unpublished manuscript.

*Spinella, M. (2005). Prefrontal substrates of empathy: Psychometric evidence in a community sample. *Biological Psychology*, 70, 175-181. doi:10.1016/j.biopsycho.2004.01.005

Staff, J. & Kreager, D.A. (2008). Too cool for school? Violence, peer status, and high school dropout. *Social Forces*, 87, 445-471. doi:10.1353/sof.0.0068

*Stanford, M.S., Greve, K.W., & Dickens, T.J. (1995). Irritability and impulsiveness: Relationship to self reported impulsive aggression. *Personality and Individual Differences*, 19, 757-760. doi:10.1016/0191-8869(95)00144-U

*Stanford, M.S., Greve, K.W., Boudreaux, J.K, Mathias, C.W., & Brumbelow, J.L. (1996). Impulsiveness and risk taking behavior: Comparison of high school and college students using the Barrett Impulsiveness Scale. *Personality and Individual Differences*, 21, 1073-1075. doi:10.1016/S0191-8869(96)00151-1

Stanford, M.S., Mathias, C.W., Dougherty, D.M., Lake, S.L., Anderson, N.E., & Patton, J.H. (2009). Fifty years of the Barratt Impulsiveness Scale: An update and review. *Personality and Individual Differences,* 47, 385-393. doi:10.1016/j.paid.2009.04.008

Stanovich, K. E. (2004). *The Robot's Rebellion: Finding Meaning in the Age of Darwin*. Chicago: The University of Chicago Press.

*Starrett, R.H. (1983). The conceptual commonality between impulsiveness as a personality trait and as an ego development stage. *Personality and Individual Differences*, 4, 265-274. doi:10.1016/0191-8869(83)90148-4

Stattin, H., & Magnusson, D. (1990). *Pubertal Maturation in Female Development*. Hillsdale, N.J.: Laurence Erlbaum Associates.

Stearns, S.C. (1992) *The Evolution of Life Histories*. New York: Oxford University Press.

Steffensmeier, D. (1983). Sex differences in patterns of adult crime, 1965-77: A review and assessment. *Social Forces*, 58, 1080-1108. http://dx.doi.org/10.1093/sf/58.4.1080

Steffensmeier, D.J., Allan, E.A., Harer, M.D., & Streifel, C. (1989). Age and the distribution of crime. *The American Journal of Sociology*, 94, 803-831. doi:10.1086/229069

Steffensmeier, D., & Striefel, C. (1991). Age, gender and crime across three historical periods: 1935, 1960, and 1985. *Social Forces*. 69, 869 – 894. doi:10.1093/sf/69.3.869

Steiger, J.H. (1989). *EzPATH: Causal Modeling*. Evanston; SYSTAT Inc.

Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., & Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology*, 44, 1764-1778. doi:10.1037/a0012955

Steinberg, L., O'Brien, L., Cauffman, E., Graham, S., Woolard, J., & Banich, M. (2009). Age differences in future orientation and delay discounting. *Child Development*, 80, 28-44. doi:10.1111/j.1467-8624.2008.01244.x

Sternberg, L. (2007). Risk taking in adolescence: New perspectives from brain and behavioral science. *Current Directions in Psychological Science*, 16, 55-59. doi:10.1111/j.1467-8721.2007.00475.x

*Stewart, M.E., Ebmeier, K.P., & Deary, I.J. (2004). The structure of Cloninger's tridimensional personality questionnaire in a British sample. *Personality and Individual Differences*, 36, 1403-1418. doi:10.1016/S0191-8869(03)00237-X

*Stoltenberg, S.F., Batien, B.D., & Birgenheir, D.G. (2008). Does gender moderate associations among impulsivity and health-risk behaviors? *Addictive Behaviors*, 33, 252-265. doi:10.1016/j.addbeh.2007.09.004

*Stoltenberg, S.F., Glass, J.M., Chermack, S.T., Flynn, H.A., Li, S., & Weston, M.E., et al. (2006). Possible association between response inhibition and a variant in the brain-expressed tryptophan hydroxylase-2 gene. *Psychiatric Genetics*, 16, 35-38. doi:10.1097/01.ypg.0000176528.30362.34

Stroop, J.P. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18,* 643-662. doi:10.1037/h0054651

Su, R., Rounds, J., & Armstrong, P.I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, 135, 859-884. doi:10.1037/a0017364

Su, X., Simons, R.L., & Simons, L.G. (2011). Interparental aggression and antisocial behavior among African American youth: a simultaneous test of competing explanations. *Journal of Youth and Adolescence*, 40, 1489-1502. doi:10.1007/s10964-011-9673-3

*Sullivan, K.T. (1997). Contributions of personality and behavior to change in marital satisfaction. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 58, (6-B), 3328.

Surbey, M. K. (1990). Family composition, stress, and the timing of human menarche. In Ziegler, T.E. & Bercovitch, F.B. (Eds.), *Socioendocrinology of Primate Reproduction. Monographs in Primatology* (Vol. 13, pp. 11 – 32). New York: Wiley-Liss.

Sutton, S.K., & Davidson, R.J. (1997). Prefrontal brain asymmetry: A biological substrate of the behavioural approach and inhibition systems. *Psychological Science*, 8, 204-210. doi:10.1111/j.1467-9280.1997.tb00413.x

Swann, A.C., Bjork, J.M., Moeller, F.G., & Dougherty, D.M. (2002). Two models of impulsivity: Relationship to personality traits and psychopathology. *Biological Psychiatry*, 51, 988-994. doi:10.1016/S0006-3223(01)01357-9

Swanson, M.C.J., Bland, R.C., & Newman, S.C. (1994). Antisocial personality disorders. *Acta Psychiatrica Scandinavica*, 89, 63-70. doi:10.1111/j.1600-0447.1994.tb05792.x

Tal, I., Hill, D., Figueredo, A.J., Frias-Armenta, M., & Corral-Verdugo, V. (2006). An evolutionary approach to explaining water conservation behaviour. *Medio Ambiente y Comportamiento Humano*, 7, 7-27.

Tan, L.H. & Quinlivan, J.A. (2006). Domestic violence, single parenthood, and fathers in the setting of teenage pregnancy. *Journal of Adolescent Health*, 38, 201-207. doi:10.1016/j.jadohealth.2004.10.014

Tangney, J.P., Baumeister, R.F., & Boone, A.L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, 72, 271-324. doi:10.1111/j.0022-3506.2004.00263.x

Tanner, J. M. (1990). *Foetus into Man: Physical Growth from Conception to Maturity*. Cambridge, MA: Harvard University Press.

Taylor, C.E. and Condra, C. (1980). r selection and K selection in *Drosophila pseudoobscura*. *Evolution*, 34, 1183-1193. doi:10.2307%2F2408299

*Taylor, J. (2005). Substance use disorders and cluster B personality disorders: Physiological, cognitive, and environmental correlates in a college sample. *American Journal of Drug and Alcohol Abuse*, 31, 515-535.10.1081/ada-200068107.

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A. R., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: Tend-and-befriend, not fight-or-flight. *Psychological Review*, 107, 411-429. doi:10.1037/0033-295X.107.3.411

Tellegen, A. (1982). *Brief manual for the Differential Personality Questionnaire.* University of Minnesota Press.

Teuscher, U., & Mitchell, S.H. (2011). Relation between time perspective and delay discounting: a literature review. *The Psychological Record,* 61, 613-632.

Theokas, C., & Lerner, R.M. (2006). Observed ecological assets in families, schools and neighborhoods: conceptualization, measurement and relations with positive and negative developmental outcomes. *Applied Developmental Science,* 10, 61-74. doi:10.1207/s1532480xads1002_2

Thiessen, D. (1994). Environmental tracking by females: Sexual lability. *Human Nature,* 5, 167-202. doi:10.1007/BF02692160

*Thompson, M.P., Ho, C-H., & Kingree, J.B. (2007). Prospective associations between delinquency and suicidal behaviors in a nationally representative sample. *Journal of Adolescent Health,* 40, 232-237. doi:10.1016/j.jadohealth.2006.10.016

Thornhill, R, & Fincher, C.L. (2011). Parasite stress promotes homicide and child maltreatment. *Philosophic Transactions of the Royal Society B,* 366, 3466-3477. doi:10.1098/rstb.2011.0052

*Tinius, T.P. (2003). The Intermediate Visual and Auditory Continuous Performance Test as a neuropsychological measure. *Archives of Clinical Neuropsychology,* 18, 199-214. doi:10.1093/arclin/18.2.199

Tittle, C. R., Ward, D. A., & Grasmick, H. G. (2003). Gender, age, and crime/deviance: A challenge to self-control theory. *Journal of Research in Crime and Delinquency*, 40, 426–453. doi:10.1177/0022427803256074

Torres-Rouff, C. & Costa-Junqueira, M.A. (2006). Interpersonal violence in prehistoric San Pedro de Atacama, Chile: behavioral implications of environmental stress. *American Journal of Physical Anthropology*, 130, 60-70. doi:10.1002/ajpa.20315

*Torrubia, R., Avila, C., Molto, J., & Caseras, X. (2001). The Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) as a measure of Gray's anxiety and impulsivity dimensions. *Personality and Individual Differences,* 31, 837-862. doi:10.1016/S0191-8869(00)00183-5

Tourangeau, R. & Yan, T. (2007). Sensitive questions in surveys. *Psychological Bulletin*, 133, 859–83. doi:10.1037/0033-2909.133.5.859

*Toyer, E.A. (1999). Development and validation of the A-ADHD: An MMPI-A scale to assess Attention-Deficit Hyperactivity Disorder in adolescents. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 60, (3-B), 1319.

Tremblay, L., & Frigon, J.Y. (2005). Precocious puberty in adolescent girls: A biomarker of later psychosocial adjustment problems. *Child Psychiatry and Human Development,* 36, 73-94. doi:10.1007/s10578-004-3489-2

Trivers, R.L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual Selection and the Descent of Man 1871-1971* (pp. 136-179). Chicago: Aldine.

Trivers, R.L. (1985). *Social Evolution*. Menlo Park, CA: Benjamin/Cummings.

Trostel, P. A., & Taylor, G. A. (2001). A theory of time preference. *Economic Inquiry*, 39, 379–395. doi:/10.1093/ei/39.3.379

Tung, Y., Lee, J., Tsai, W., & Hsiao, P. (2004). Physiological changes of adrenal androgens in childhood. *Journal of Formosa Medical Association*, 103, 921 – 924.

U.S. Department of Justice (n.d.). *Crime in the United States, 2008.* Retrieved March 15, 2010, from http://www.fbi.gov/ucr/cius2008/data/table_42.html

United States Department of Justice (2011). Homicide trends in the United States, 1980-2008. *Bureau of Justice Statistics.*

Upchurch, D.M., Aneshensal , C.S., Sucoff, C.A., & Levy-Storms, L. (1999). Neighborhood and family contexts of adolescent sexual activity. *Journal of Marriage and the Family*, 61, 920-933. doi:10.2307/354013

Upchurch, D.M., Ley-Storms, L., Sucoff, C.A., & Aneshensel, C.S. (1998). Gender and ethnic differences in the timing of first sexual intercourse. *Family, Planning Perspectives*, 30, 121-127. doi:10.2307/2991625

*Uzieblo, K., Verschuere, B., & Crombez, G. (2007). The Psychopathic Personality Inventory: Construct validity of the two-factor structure. *Personality and Individual Differences*, 43, 657-667. doi:10.1016/j.paid.2007.01.008

*van den Bree, M.B.M., Przybeck, T.R., & Cloninger, C.R. (2006). Diet and personality: Associations in a population-based sample. *Appetite*, 46, 177-188. doi:10.1016/j.appet.2005.12.004

*van den Broek, M.D., Bradshaw, C.M., & Szabadi, E. (1992). The relationship between 'impulsiveness' and hemispheric functional asymmetry, investigated with a divided visual field word recognition task. *Personality and Individual Differences,* 13, 355-360. doi:10.1016/0191-8869(92)90114-5

*Van der Linden, M., d'Acremont, M., Zermatten, A., Jermann, F., Laroi, F., & Willems, S. et al. (2006). A French adaptation of the UPPS impulsive behaviour scale: Confirmatory factor analysis in a sample of undergraduate students. *European Journal of Psychological Assessment, 22,* 38-42. doi: 10.1027/1015-5759.22.1.38

Van Wingen, G., Mattern, C., Verkes, R.J., Buitelaar, J., & Fernandez, G. (2010). Testosterone reduces amygdala–orbitofrontal cortex coupling. *Psychoneuroendocrinology*, 35, 105–113. doi:10.1016/j.psyneuen.2009.09.007

*Vazsonyi, A.T., Cleveland, H.H., & Wiebe, R.P. (2006). Does the effect of impulsivity on delinquency vary by level of neighbourhood disadvantage? *Criminal Justice and Behavior*, 33, 511-541. doi:10.1177/0093854806287318

*Verdejo-Garcia, A., Bechara, A., Recknor, E.C., & Perez-Garcia, M. (2007). Negative emotion-driven impulsivity predicts substance dependence problems. *Drug and Alcohol Dependence*, 91, 213-219. doi:10.1016/j.drugalcdep.2007.05.025

*Vigil-Colet, A. (2007). Impulsivity and decision making in the balloon analogue risk-taking task. *Personality and Individual Differences,* 43, 37-45. doi:10.1016/j.paid.2006.11.005

*Vigil-Colet, A., & Codorniu-Raga, M.J. (2004). Aggression and inhibition deficits, the role of functional and dysfunctional impulsivity. *Personality and Individual Differences,* 37, 1431-1440. doi:10.1016/j.paid.2004.01.013

*Vigil-Colet, A., & Morales-Vives, F. (2005). How impulsivity is related to intelligence and academic achievement. *The Spanish Journal of Psychology,* 8, 199-204.

*Vigil-Colet, A., Morales-Vives, F., & Tous, J. (2008). The relationships between functional and dysfunctional impulsivity and aggression across different samples. *The Spanish Journal of Psychology*, 11, 480-487.

Vitaro, F., Brendgen, M., & Tremblay, R.E. (2002). Reactively and proactively aggressive children: antecedent and subsequent characteristics. *Journal of Child Psychology and Psychiatry*, 43, 495-505. doi:10.1111/1469-7610.00040

Voland, E. (1988). Differential infant and child mortality in an evolutionary perspective: Data from late 17th to 19th century Ostfriesland (Germany). In Betzig, L., Borgerhoff Mulder, M., & Turke, P. (Eds), *Human Reproductive Behaviour: A Darwinian Perspective* (pp. 253-261). Cambridge, England: Cambridge University Press.

Volman, I., Toni, I., Verhagen, L., & Roelofs, K. (2011). Endogenous testosterone modulates prefrontal–amygdala connectivity during social emotional behavior. *Cerebral Cortex*, 21,2282-2290. doi:10.1093/cercor/bhr001

*von Knorring, L., Almay, B.G., & Johansson, F. (1987). Personality traits in patients with Idiopathic Pain Disorder. *Acta Psychiatrica Scandinavia*, 76, 490-498. doi:10.1111/j.1600-0447.1987.tb02909.x

Voyer, D., Voyer, S., & Bryden, M. P. (1995). Magnitude of sex-differences in spatial abilities: A meta-analysis and consideration of critical variables. *Psychological Bulletin,* 117, 250-270. doi:10.1037/0033-2909.117.2.250

Wager, T.D., Davidson, M.L., Hughes, B.L., Lindquist, M.A., & Ochsner, K.N. (2008). Prefrontal-subcortical pathways mediating successful emotion regulation. *Neuron,* 59, 1037–1050. doi:10.1016/j.neuron.2008.09.006

*Walderhaug, E., Magnusson, A., Neumeister, A., Lappalainen, J., Lunde, H., Refsum, H., et al., (2007). Interactive effects of sex and 5-HTTLPR on mood and impulsivity during tryptophan depletion in healthy people. *Biological Psychiatry*, 62, 593-599. doi:10.1016/j.biopsych.2007.02.012

Walker, R., Burger, O., Wagner, J., & Von Rueden, C. R. (2006). Evolution of brain size and juvenile periods in primates. *Journal of Human Evolution*, 51, 480–489. doi:10.1016/j.jhevol.2006.06.002

Wallace, D. & Wallace, R. (1998). Scales of geography, time and population: the study of violence as a public health problem. *American Journal of Public Health*, 88, 1853-1858. doi:10.2105/AJPH.88.12.1853

Wallace, J.F., Malterer, M.B., & Newman, J.P. (2009). Mapping Gray's BIS and BAS constructs onto Factor 1 and Factor 2 of Hare's Psychopathy Checklist - Revised. *Personality and Individual Differences,* 47, 812-816. doi:10.1016/j.paid.2009.06.019

Waters, E., Weinfield, N. S. & Hamilton, C. E. (2000) The stability of attachment security from infancy to adolescence to early adulthood: General discussion. *Child Development,* 71, 703-706. doi:10.1111/1467-8624.00179

Weaver, T.L., Sanders, C.K., Campbell, C.L., & Schnable, M. (2009). Development and preliminary psychometric evaluation of the domestic violence-related financial issues scale (DV-FI). *Journal of Interpersonal Violence*, 24, 569-585. doi:10.1177/0886260508317176

Webster, G.D., Garber, J.A., Gesselman, A.N., Crosier, B.S., & Schember, T.O. (2014). A life history theory, father absence and menarche: A meta-analysis. *Evolutionary Psychology*, 12, 273-294.

Wei, E.H., Loeber, R. & Stouthhamer-Loeber, M. (2002). How many of the offspring born to teenage fathers are produced by repeated serious delinquents? *Criminal Behaviour and Mental Health,* 12, 83-98. doi:10.1002/cbm.488

Weinfield, N.S. (2000) Attachment from infancy and adulthood in a high-risk sample: Continuity, discontinuity, and their correlates. *Child Development,* 71, 695–702. doi:10.1111/1467-8624.00178

Weinshenker, N.J., & Siegel, A. (2002). Bimodal classification of aggression: Affective defence and predatory attack. *Aggression and Violent Behavior*, 7, 237-250. doi:10.1016/S1359-1789(01)00042-8

Weinstein, M. & Stark, M. (1994) Behavioral and biological determinants of fecundability. *Annals of the New York Academy of Sciences,* 709, 128–144. doi:10.1111/j.1749-6632.1994.tb30393.x

*Weller, L.A. (2001). Cognitive inhibition and impulsivity in adult children of alcoholics and controls. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, 61, (11-B), 6154.

Wenner, C. J., Figueredo, A. J., Rushton, J. P., & Jacobs, W. J. (2007). Executive functions, general intelligence, life history, psychopathic attitudes, and deviant behavior. Paper. *Annual Meeting Of The International Society For Intelligence Research, Amsterdam, The Netherlands*.

Wenner, C.J., Bianchi, J., Figueredo, A.J., Rushton, J.P., & Jacobs, W.J. (2013). Life history theory and social deviance: The mediating role of executive function. *Intelligence*, 41, 102-113.

Were, M. (2007). Determinants of teenage pregnancies: The case of Busia district in Kenya. *Economics and Human Biology*, 5, 322-339. doi:10.1016/j.ehb.2007.03.005

West-Eberhard, M. J. (1983). Sexual selection, social competition and speciation. *Quarterly Review of Biology*, 55, 155–183. doi:10.1016/j.intell.2012.11.004

West-Eberhard, M.J. (2003). *Developmental Plasticity and Evolution*. New York: Oxford University Press.

*Weyers, P., Krebs, H., & Janke, W. (1995). Reliability and construct validity of the German versions of Cloninger's Tridimensional Personality Questionnaire. *Personality and Individual Differences*, 19, 853-861. doi:10.1016/S0191-8869(95)00128-X

White, H.R. & Johnson, V. (1988). Risk taking as a predictor of adolescent sexuality and use of contraception. *Journal of Adolescent Research*, 3, 317-331. doi:10.1177/074355488833007

White, J.L., Moffitt, T.E., Caspi, A., Bartusch, D.J., Needles, D.J., & Stouthamer-Loeber, M. (1994). Measuring impulsivity and examining its relationship to delinquency. *Journal of Abnormal Psychology*, 103, 192-205. doi:10.1037/0021-843X.103.2.192

*White, T.L., Lejuez, C.W., & de Wit, H. (2007). Personality and gender differences in effects of d-amphetamine on risk taking. *Experimental and Clinical Psychopharmacology*, 15, 599-609. doi:10.1037/1064-1297.15.6.599

*Whiteside, S.P., & Lynam, D.R. (2001). The Five Factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, 30, 669-689. doi:10.1016/S0191-8869(00)00064-7

Wilding, J., Pankhania, P., & Williams, A. (2007). Effects of speed and accuracy instructions on performance in a visual search task by children with good or poor attention. *British Journal of Psychology*, 98, 127-139. doi:10.1348/000712606X109666

Wilkinson, R. G., & Pickett, K. E. (2009). *The Spirit Level: Why Equality is Better for Everyone*. London: Penguin.

Wilkinson, R.G., Kawachi, I., & Kennedy, B.P. (1998). Mortality, the social environment, crime and violence. *Sociology of Health and Illness*, 20, 578-597.

Wilson, J.Q., and Herrnstein, R.J. (1985). *Crime and Human Nature: The Definitive Study of the Causes of Crime*. Simon and Schuster: New York

Wilson, L.C., & Scarpa, A. (2010). The link between sensation seeking and aggression: a meta-analytic review. *Aggressive Behaviour, 35*, 1-10. doi:10.1002/ab.20369

Wilson, M., & Daly, M. (1985). Competitiveness, risk taking and violence: the young male syndrome. *Ethology and Sociobiology*, 6, 59–73. doi:10.1016/0162-3095(85)90041-X.

Wilson, M., & Daly, M. (1997). Life Expectancy, Economic Inequality, Homicide and Reproductive Timing in Chicago Neighbourhoods. *British Medical Journal*, 314, 1271-1274. doi:10.1136/bmj.314.7089.1271

*Wilson, M., & Daly, M. (2006). Are juvenile offenders extreme future discounters? *Psychological Science*, 17, 989-994. doi:10.1111/j.1467-9280.2006.01817.x

Wilson, M., Daly, M., & Pound, N. (2002). An evolutionary psychological perspective on the modulation of confrontational competition and risk taking. In Pfaff, D.W., Arnold, A.P., Etgen, A.M., Fahrbach, S.E., & Rubin, R.T. (Eds). *Hormones, Brain and Behavior*, 5, pp. 381-408. San Diego CA: Academic Press

*Wingo, M.K. (2002). The adolescent stress response to a naturalistic driving stressor. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 63, (2-B), 1082.

Wolff, J.O. & MacDonald, D.W. (2004). Promiscuous females protect their offspring. *Trends in Ecology and Evolution*, 19, 127-134. doi.org/10.1016/j.tree.2003.12.009

Wood, J.L., Heitmiller, D., Andreason, N.C., & Nopoulos, P. (2008). Morphology of the ventral frontal cortex: Relationship to femininity and social cognition. *Cerebral Cortex*, 18, 534-540. doi:10.1093/cercor/bhm079

Wood, P. B., Pfefferbaum, B., & Arneklev, B. J. (1993). Risk-taking and self-control: Social psychological correlates of delinquency. *Journal of Crime and Justice*, 16, 111– 130. doi:10.1080/0735648X.1993.9721481

Woodley, M. A. (2011). The cognitive differentiation–integration effort hypothesis: A synthesis between the fitness indicator and life history models of human intelligence. *Review of General Psychology*, 15, 228. doi:10.1037/a0024348

Woodley, M.A., & Fernandes, H.B.F. (2014). Strategic and cognitive differentiation-integration effort in a study of 76 countries. *Personality and Individual Differences*, 57, 3-7. doi:10.1016/j.paid.2013.09.010

Woodley, M.A., Fernandes, H.B.F., & Madison, G. (2014). Strategic differentiation–integration effort amongst the 47 prefectures of Japan. *Personality and Individual Differences*, 63, 64-68. doi:10.1016/j.paid.2014.01.043

Woodley, M.A., Figueredo, A. J., Brown, S. D., & Ross, K. C. (2013). Four successful tests of the Cognitive Differentiation–Integration Effort hypothesis. *Intelligence*, 41, 832-842. doi:10.1016/j.intell.2013.02.002.

Woodward, L. J., & Fergusson, D. M. (1999). Early conduct problems and later risk of teenage pregnancy in girls. *Development and Psychopathology*, 11, 127–141. doi:10.1017/S0954579499001984.

Xiao, G., Lei, L., Dempsey, P. G., Lu, B. & Liang, Y. (2005). Isometric muscle strength and anthropometric characteristics of a Chinese sample. *International Journal of Industrial Ergonomics* 35, 674–79. doi:10.1016/j.ergon.2005.02.003

Xie, H., Cairns, B. D., & Cairns, R. B. (2001). Predicting teen motherhood and teen fatherhood: individual characteristics and peer affiliations. *Social Development*, 10, 488–511. doi:10.1111/1467-9507.00177.

*Yang, H. (2002). Examination of perceptions of leisure boredom, personal characteristics, and family functions as predictors of aggressive behavioral tendencies of university students. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 63, (5-B), 2570.

*Zaleskiewicz, T. (2001). Beyond risk seeking and risk aversion: Personality and the dual nature of economic risk taking. *European Journal of Personality*, 15, 105-122. doi:10.1002/per.426

Zawacki, T.M. (2002). Alcohol's role in decisions to drive after drinking. *Dissertation Abstracts International: Section B: The Sciences and Engineering,* 63, (3-B), 1613.

Zelazo, P. D., & Cunningham, W. (2007). Executive function: Mechanisms underlying emotion regulation. In Gross, J. (Ed.), *Handbook of emotion regulation* (pp. 135–158). New York: Guilford

Zelenski, J.M., & Larsen, R.J. (1999). Susceptibility to affect: A comparison of three personality inventories. *Journal of Personality*, 67, 761-791. doi: 10.1111/1467-6494.00072

Zerjal, T., Xue, Y., Bertorelle, G., Wells, R. S., Bao, W., Zhu, S., Qamar, R., Ayub, Q., Mohyuddin, A., Fu, S., Li, P., Yuldasheva, N., Ruzibakiev, R., Xu, J., Shu, Q., Du, R., Yang, H., Hurles, M. E., Robinson, E., Gerelsaikhan, T., Dashnyam, B., Mehdi, S. Q. & Tyler-Smith, C. (2003). The genetic legacy of the Mongols. *American Journal of Human Genetics*, 72, 717–721. doi.org/10.1086/367774

Zimbardo, P.G., & Boyd, J.N. (1999). Putting time in perspective: a valid, reliable individual differences metric. *Journal of Personality and Social Psychology*, 77, 1271-1288. doi:10.1037/0022-3514.77.6.1271

*Zimmerman, G., Rossier, J., & Meyer de Stadelhofen, F. (2004). Validation of the French version of the Eysenck's impulsiveness questionnaire (I7): Influence of personality, gender and religion. *Annales Médico Psycholgiques*, 162, 116-121. doi: 10.1016/j.amp.2003.02.001

*Zimmerman, G., Rossier, J., Meyer de Stadelhofen, F., & Gaillard, F. (2005). Alexithymia assessment and relations with dimensions of personality. *European Journal of Psychological Assessment*, 21, 23-33. doi:10.1027/1015-5759.21.1.23

Zuckerman, M. (1971). Dimensions of sensation seeking. *Journal of Consulting and Clinical Psychology*, 36, 45–52. doi:10.1037/h0030478

Zuckerman, M. (1979). *Sensation Seeking: Beyond the Optimal Level of Arousal*. Hillsdale, NJ: Erlbaum.

Zuckerman, M. (1989). Personality in the third dimension: A psychobiological approach. *Personality and Individual Differences*, 10, 391-418. doi:10.1016/0191-8869(89)90004-4

Zuckerman, M. (1994). *Behavioral expressions and biosocial bases of sensation seeking*. New York, NY: Cambridge University Press. doi:10.1016/B0-08-043076-7/01772-1

Zuckerman, M. (2006). *Sensation Seeking and Risky Behavior*. Washington DC: American Psychological Association. doi:10.1037/11555-000

Zuckerman, M., Bone, R.N., Neary, R., Mangelsdorff, D. & Brustman, B. (1972). What is the sensation seeker? Personality trait and experience correlates of the sensation seeking scales. *Journal of Consulting Clinical Psychology*, 39, 308-321. doi:10.1037/h0033398

Zuckerman, M., & Cloninger, C. R. (1996). Relationships between Cloninger's, Zuckerman's, and Eysenck's dimensions of personality. *Personality and Individual Differences*, 21, 283–285. doi:10.1016/0191-8869(96)00042-6

*Zuckerman, M., Eysenck, S., & Eysenck, H.J. (1978). Sensation seeking in England and America: Cross-cultural, age and sex comparisons. *Journal of Consulting and Clinical Psychology*, 46, 139-149. doi:10.1037/0022-006X.46.1.139

Zuckerman, M., & Kuhlman, D. M. (1993*).Norms for the Zuckerman– Kuhlman Personality Questionnaire (ZKPQ)*. Unpublished manuscript, Department of Psychology, University of Delaware, Newark.

Zuckerman, M., & Kuhlman, D. M. (2000). Personality and risk-taking: Common biosocial factors. *Journal of Personality*, 68, 999–1029. doi:10.1111/1467-6494.00124

*Zuckerman, M., Kuhlman, D.M., & Carmac, C., (1988). What lies beyond E and N? Factor analyses of scales believed to measure basic dimensions of personality. *Journal of Personality and Social Psychology*, 54, 96-107. doi:10.1037/0022-3514.54.1.96

Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P., & Kraft, M. (1993). A comparison of three structural models for personality: The Big Three, the Big Five, and the Alternative Five. *Journal of Personality and Social Psychology*, 65, 757–768. doi:10.1037/0022-3514.65.4.757.

Zuckerman, M., Tushup, R. & Finner, S. (1976). Sexual attitudes and experience: Attitude and personality correlations and changes produced by a course in sexuality. *Journal of Consulting and Clinical Psychology*, 44, 7 -19. doi:10.1037/0022-006X.44.1.7

Zumbo, B. D., Gadermann, A. M., & Zeisser, C. (2007). Ordinal versions of coefficients alpha and theta for Likert rating scales. *Journal of Modern Applied Statistical Methods*, 6, 21-29.